

**DRAFT
TOTAL MAXIMUM DAILY LOAD (TMDL)**

**For
Fecal and Total Coliform
In
Apalachicola - Chipola Basin**

**(Includes TMDLs for Apalachicola Bay, Scipio River,
Apalachicola River, Huckleberry Creek, Thompson
Pond, and Muddy Branch)**

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LIST OF ABBREVIATIONS

AWT	Advanced Waste Treatment
BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
CFU	Colony Forming Units
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDACS	Florida Department Agriculture and Consumer Services
FDEP	Florida Department Environmental Protection
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
Rf3	Reach File 3
RM	River Mile
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WMP	Water Management Plan

DRAFT SUMMARY SHEET
EPA DEVELOPED Total Maximum Daily Load (TMDL)

1. 303(d) Listed Waterbody Information

State: Florida

County: Franklin, Liberty, Gulf, and Jackson

Major River Basin: Apalachicola Bay (HUC 03130014), Apalachicola River Basin (HUC 03130011), Chattahoochee River Basin (HUC 03130004), and Chipola River Basin (HUC 03130012)

Impaired Waterbodies (1998 303(d) List):

WBID	Segment Name and Type	River Basin	County	Constituent(s)
1274	Apalachicola Bay (estuary)	Apalachicola Bay		Fecal and Total Coliform
1274B	Apalachicola Bay (estuary)	Apalachicola Bay		Total Coliform
375A	Apalachicola - Scipio Creek (marine water)	Apalachicola River Basin	Franklin	Fecal and Total Coliform
375B	Apalachicola River (marine water)	Apalachicola River Basin	Franklin	Total Coliform
1286	Huckleberry Creek (fresh water)	Apalachicola River	Franklin	Total Coliform
272	Thompson Pond (fresh water)	Chattahoochee River Basin	Jackson	Total Coliform
175	Muddy Branch (fresh water)	Chipola River Basin	Jackson	Fecal and Total Coliform

2. TMDL Endpoints (i.e., Targets)

Class II Waters (estuary):

Fecal Coliforms: 43 MPN/100mL

Total Coliform: 230 MPN/100mL

Class III Waters (fresh and marine):

Fecal Coliforms: 400 MPN/100mL

Total Coliform: 2400 MPN/100mL

3. Fecal Coliform Allocation:

WBID	WLA _{Continuous}	WLA _{MS4} (reduction)	LA (cfu/day)	TMDL (cfu/day)	Reduction (to nonpoint sources)
1274	5.44×10^9	N/A	4.94×10^{13}	4.94×10^{13}	0 (see note 2)
375A	5.44×10^9	N/A	4.94×10^{13}	4.94×10^{13}	30% (see note 3)
175	N/A	N/A	5.04×10^9	5.04×10^9	50% reduction

Note:

1. N/A = not applicable
2. Meeting water quality criteria in Apalachicola River should result in attainment of standards in Apalachicola Bay
3. Overall reduction required from Apalachicola River above WBID 375A

4. Total Coliform Allocation:

WBID	WLA _{Continuous}	WLA _{MS4} (reduction)	LA (cfu/day)	TMDL (cfu/day)	Reduction (to nonpoint sources)
1286	N/A	N/A	1.51×10^{11}	1.51×10^{11}	82%

WBID	WLA_{Continuous}	WLA_{MS4} (reduction)	LA (cfu/day)	TMDL (cfu/day)	Reduction (to nonpoint sources)
1274	N/A	N/A	2.70×10^{14}	2.70×10^{14}	See note 2
1274B	N/A	N/A	2.70×10^{14}	2.70×10^{14}	See note 2
375A	N/A	N/A	2.70×10^{14}	2.70×10^{14}	See note 2
375B	N/A	N/A	2.70×10^{14}	2.70×10^{14}	15%
272	N/A	N/A	74% reduction	74% reduction	74%
175	N/A	N/A	3.02×10^{10}	3.02×10^{10}	96%

Note:

1. N/A = not applicable
2. Reductions proposed for WBID 375B should result in attainment of standards in WBID 375A and Apalachicola Bay

5. **Endangered Species (yes or blank):** Yes
6. **EPA Lead on TMDL (EPA or blank):** EPA
7. **TMDL Considers Point Source, Nonpoint Source, or both:** Both
8. **Major NPDES Discharges to surface waters:**

Facility Name	NPDES No.	Facility Type	Impacted Stream
City of Apalachicola WWTP	FL0038857	Tertiary	Huckleberry Creek (in watershed of WBIDs 375A and 1274)

TOTAL MAXIMUM DAILY LOAD (TMDL) FECAL AND TOTAL COLIFORM IN APALACHICOLA - CHIPOLA BASIN

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework DEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The Group 2 basin includes waters in the Apalachicola River basin, Apalachicola Bay, Chipola River basin, Hillsborough River basin and Tampa Bay basin. Group 2 waters were first assessed in 2001 with plans to revisit water management issues in 2006. FDEP established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. The Apalachicola–Chipola River basins are located in the Northwest Florida Water Management District (NFWFMD).

For the purpose of planning and management, the WMDs divided the district into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. These planning units contain smaller, hydrological based units called drainage basins, which are further divided into “water segments”. A water segment usually contains only one unique waterbody type (stream, lake, canal, etc.) and is about 5 square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment.

2. PROBLEM DEFINITION

Florida's final 1998 Section 303(d) list identified numerous WBIDs in the Apalachicola – Chipola basin as not supporting water quality standards (WQS). After assessing all readily available water quality data, EPA is responsible for developing fecal and total coliform TMDLs in 6 WBIDs (see Table 1). The geographic locations of these TMDLs are shown in Figure 1. The TMDLs addressed in this document are being established pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

Table 1. Coliform TMDLs in Apalachicola - Chipola Basin

WBID	Name	Planning Unit	Parameter of Concern
1274	Apalachicola Bay	Apalachicola Bay	Fecal and Total Coliform
1274B	Apalachicola Bay	Apalachicola Bay	Total Coliform

WBID	Name	Planning Unit	Parameter of Concern
375A	Apalachicola R - Scipio Creek	Apalachicola River Basin	Fecal and Total Coliform
375B	Apalachicola River	Apalachicola River Basin	Total Coliform
1286	Huckleberry Creek	Apalachicola River Basin	Total Coliform
272	Thompson Pond	Chattahoochee River Basin	Total Coliform
175	Muddy Branch	Chipola River Basin	Fecal and Total Coliform

The waterbodies listed in Table 1 are designated as Class III waters with the exception of Apalachicola Bay, WBIDs 1274 and 1274B, designated as Class II water. The designated use of Class II waters is shellfish propagation or harvesting, whereas the designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class III waters are further categorized based on fresh or marine waters. Water quality criteria for fecal and total coliform do not vary between Class III fresh or marine waters. Scipio Creek (WBID 375A) discharges directly into Apalachicola Bay and must meet the more stringent water quality standards of the downstream segment. The TMDLs for Scipio Creek and Apalachicola Bay (WBIDs 1274 and 1274B) are based on Class II water quality criteria.

To determine the status of surface water quality in the state, three categories of data – chemistry data, biological data, and fish consumption advisories – were evaluated to determine potential impairments. The level of impairment is defined in the Identification of Impaired Surface Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (F.A.C.). The IWR defines the threshold for determining if waters should be included on the state's planning list and verified list. Potential impairments are determined by assessing whether a waterbody meets the criteria for inclusion on the planning list. Once a waterbody is on the planning list, additional data and information will be collected and examined to determine if the water should be included on the verified list.

The format of the remainder of this report is as follows: Chapter 3 is a general description of the impaired watersheds; Chapter 4 describes the water quality standard and target criteria for the TMDLs; and Chapter 5 describes the development of the coliform TMDLs. Water quality data collected in the WBIDs identified in Table 1 are presented in Appendix A. Details of TMDL calculations are provided in Appendix B. Documentation of the numerical model developed for Apalachicola Bay is provided in Appendix C.

In addition to the TMDLs listed in Table 1, EPA is proposing a fecal coliform TMDL for Huckleberry Creek. This TMDL was developed by FDEP, as they could not submit this TMDL to EPA for approval/disapproval action in the allocated timeframe provided in the Consent Decree. However, FDEP is continuing the process of establishing the Huckleberry Creek fecal coliform TMDL to submit to EPA for approval/disapproval action. It is EPA's expectation that FDEP will establish the Huckleberry Creek TMDL and submit to EPA in the near future. At this time, EPA proposes this TMDL under V.A.1 of the Consent Decree. The remainder of this document is specific to the TMDLs developed by EPA.

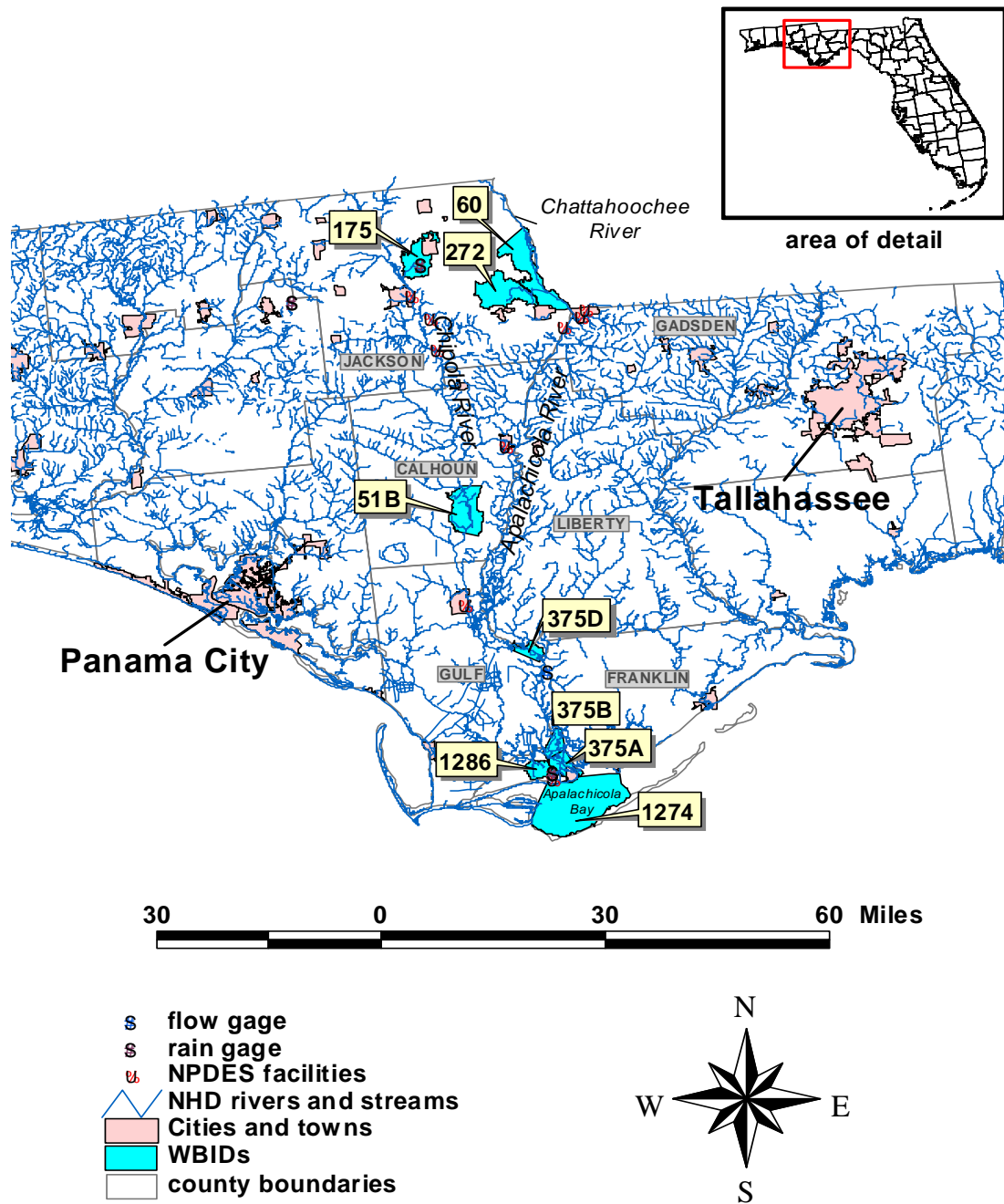


Figure 1. Location of WBIDs in Apalachicola-Chipola Basin Impaired by Coliforms

3. WATERSHED DESCRIPTION

The Apalachicola-Chipola basin is defined by USGS Hydrologic Unit Code (HUC) 03130014 (Apalachicola Bay), 03130011 (Apalachicola River), 03130004 (Chattahoochee River), and 03130012 (Chipola River). The following description of the impaired watersheds is from the Basin Status Reports (FDEP, 2001, 2002). These documents should be consulted for additional details.

The Apalachicola-Chipola Basin encompasses more than 3,067 square miles of the state, including approximately 212 square miles of Apalachicola Bay waters. Streams in the Apalachicola watershed have been modified by dredge-and-fill activities from past and present silviculture practices. Planted pines have replaced native hardwoods along stream banks, the topography flatten, stream channels have filled from logging roads and clear-cutting, and deep ditches have lowered the basin's water table. Additional impacts have been caused by the conversion of forestland to agriculture and municipal and industrial discharges and water withdrawals. The predominate land cover in the impaired watersheds is forest and wetlands (see Table 2).

The Upper Floridan aquifer underlies the WBIDs in the Florida Panhandle. The geomorphology and hydrogeology of the Apalachicola-Chipola basin are typical of a karstic terrain. As the carbonate rocks beneath the land surface chemically weather and collapse, sinkholes commonly develop. In the region of Jackson County more than 2,800 mapable surface karstic features are present. Most of the surface runoff of rainfall in karst terrains seeps into the Upper Floridan aquifer.

The Apalachicola-Chipola Basin's population density is relatively low. Impaired WBIDs 375A and 375B are located within Franklin County. Between 1990 and 2000, the county population increased 23 percent. Phase I or II MS4s are not located in the WBIDs addressed in this report.

The Apalachicola Bay estuary serves as the interface between the freshwater uplands and the Gulf of Mexico. Four barrier islands bound the bay: St. Vincent Island, St. George Island, Cape St. George Island, and Dog Island. The Apalachicola Bay estuary supports the largest oyster-harvesting industry in Florida, as well as extensive shrimping, crabbing, and commercial fishing. The federal government has classified the Bay as a National Estuarine Reserve.

Chapter 62R-7 of the F.A.C. details DEP's authority to regulate harvesting, processing, and shipping of shellfish according to the National Shellfish Sanitation Program (NSSP) standards and guidelines. A basic concept of the NSSP is to control sanitary quality of shellfish by allowing shellfish harvesting only from waters of high bacteriological quality. The NSSP Manual of Operations, Part 1 (USDOH, 1985) requires a sanitary survey of shellfish areas to identify and evaluate all actual and potential sources of pollution which may affect the shellfish growing area; determine the distance such sources to the growing area; assess the effectiveness and reliability of sewage treatment systems; and ascertain the presence of poisonous or deleterious substances (e.g., industrial and agricultural wastes, pesticides, or radionuclides).

A sanitary survey includes the collection of growing area water samples and their analysis for bacterial quality. The collection of samples provides a profile for periods defining adverse pollution conditions which reflect adverse meteorological, hydrographic, seasonal, and point sources of pollution to assure that the requirements for classifying growing areas as approved, conditionally approved, restricted, or conditionally restricted are met. Sanitary surveys are formally reviewed on an annual basis and completely reevaluated every three years. The 1997 Sanitary Survey completed in Apalachicola Bay should be consulted for additional information.

Table 2. Land Cover Distribution¹ (acres)

WBID	Residential	Com, Ind, Public	Agriculture	Rangeland	Forest	Water	Wetlands	Transp and utilities	Barren&extractive	Total (acres)
<i>Apalachicola - Chipola River Basin</i>										
1274	31.78	28.54	0.00	62.79	25.85	6.10	168.57	1.75	46.38	371.76
375A	901.33	249.57	0.00	23.62	1077.04	919.32	3947.52	121.55	10.75	7250.70
375B	7.71	0.00	0.00	4.13	26.24	617.89	4022.34	0.00	13.89	4692.19
1286	31.76	0.00	0.00	97.69	3060.27	46.62	1694.72	0.00	0.00	4931.05
272	513.52	51.12	8021.08	684.48	5794.34	534.91	1014.85	36.30	1.24	16651.84
175	721.37	244.21	6709.04	93.58	4093.67	24.81	176.03	957.01	87.62	13107.34

Notes:

1. Acreage represents the land use distribution in the impaired WBID and not the entire drainage area.
2. Public lands include urban and recreational areas.
3. Rangeland includes shrubland, grassland, and herbaceous land covers.
4. Data source for Apalachicola-Chipola Basin is land cover of 1995 from the NFWFMD.

4. WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Waterbodies in the impaired WBIDs are classified as Class III waters, with the exception of Apalachicola Bay, a Class II water. The designated use classification for Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The designated use of Class II waters is shellfish propagation or harvesting. The water quality criteria for protection of Class II and III waters are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative or more stringent criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. The specific criteria for the impaired WBIDs addressed in this TMDL are as follows:

Fecal Coliform Bacteria (Class III Waters)

The most probable number (MPN) or membrane filter (MF) counts per 100 ml of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period.

When flow data are available in the WBID, the fecal coliform TMDLs are expressed as daily loads in units of counts per day. The target for the daily loads is the 10 percent of the samples can not have concentrations exceeding 400 counts/100ml as this is the more stringent of the criteria violated in the sampling data.

The fecal coliform TMDLs are also expressed in terms of the percent reduction required to achieve water quality standards. When flow data are not available in the WBID or due to geologic conditions it is not possible to estimate flow (i.e., karst geologic formation), the TMDLs are expressed only as percent reductions. The percent reduction is calculated using both the 400 criteria.

It is appropriate to use the more stringent of the acute criteria for fecal coliform TMDL development as the data indicates violations of the standard are typically related to storm events, which are short-term in nature. Violations of the chronic criteria are typically associated with point sources or non-point source continuous discharges (e.g., leaking septic systems) and typically occur during all weather conditions. Targeting the acute criteria should be protective of the geometric mean criteria (i.e., chronic criteria).

Total Coliform Bacteria (Class III Waters)

The MPN per 100 ml of total coliform bacteria shall be less than or equal to 1,000 as a monthly average nor exceed 1,000 in more than 20 percent of the samples examined during any month, and less than or equal to 2,400 at any time. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period.

The target for the total coliform TMDLs is the one-day maximum concentration of 2400 counts/100mL, as less than 10 samples were collected in a 30-day period to determine violations of the not to exceed percentage criterion or the geometric mean. Total coliform bacteria generally indicate the presence of soil-associated bacteria and result from natural influences on a water body such as rainfall runoff as well as sewage inflows (i.e., acute conditions). By protecting the acute criteria (i.e., one-day maximum) bacteria concentrations in the stream should meet the chronic criteria.

Fecal Coliform Bacteria (Class II Waters)

The MPN per 100 ml of fecal coliform bacteria shall not exceed a median value of 14 with not more than 10 percent of the samples exceeding 43, nor exceed 800 on any one day. FDEP calculates the geometric mean of all samples collected and compares this value to the 14 MPN/100ml criteria.

The target for the fecal coliform TMDLs is the not to exceed concentration of 43 counts/100mL, as this is the more stringent of the dual acute criteria. Apalachicola Bay was included on the 303(d) list as the data indicated exceedences of the 10 percent criteria and not the median concentration. Because the bay was listed because of the acute criteria, it is appropriate to develop the TMDL to acute criteria.

Total Coliform Bacteria (Class II Waters)

The median MPN shall not exceed 70, and not more than 10 percent of the samples shall exceed an MPN of 230. FDEP calculates the geometric mean of all samples and compares this value to the median criteria. The target for the total coliform TMDLs is the not to exceed concentration of 230 counts/100mL. WBID 1274B was included on the 303(d) list as the data indicated exceedences of the 10 percent criteria and not the median concentration. Because this portion of the bay was listed because of acute criteria, it is appropriate to develop the TMDL to this criteria.

5. FECAL AND TOTAL COLIFORM TMDLS

This section of the report details the development of the coliform TMDLs. Fecal coliforms are a subset of the total coliform group and indicate the presence of fecal material from warm-blooded animals. Total coliform bacteria generally indicate the presence of soil-associated bacteria and result from natural influences on a water body such as rainfall runoff as well as sewage inflows.

5.1 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

FDEP maintains ambient monitoring stations throughout the basin. All data collected at monitoring stations within the impaired WBID are used in the analysis. Table 3 provides a list of the monitoring stations. Data collected during the Group 2 listing cycle (i.e., January 1996 through December 2003) and any data collected in 2004, if available, are considered in the data assessment. Table 4 and Table 6 provide a statistical summary of the fecal and total coliform data with respect to the Class III targets. Table 5 provides a statistical summary of the fecal coliform data with respect to the Class II targets. A listing of all monitoring stations, measured coliform concentrations, and graphics showing the data with respect to the target are included in Appendix A.

Table 3. Monitoring Stations used in the Development of Coliform TMDLs

WBID	Station Name	Parameter Evaluated	Available Sampling Period	Number Samples
1274 (Apalachicola Bay)	21FLNWFD294100085020001	Total Coliform	4/23/96 – 8/20/96	3
	21FLGW S477	Total Coliform	11/20/97 – 9/21/98	6
	21FLWQA 293918408453409	Total Coliform	6/19/03	1
	21FLWQA 293937408452568	Total Coliform	6/19/03	1
	21FLWQA 293948408452446	Total Coliform	6/19/03	1
	21FLWQA 293950308452215	Total Coliform	6/19/03	1
	21FLWQA 294205408453129	Total Coliform	6/19/03	1
	21FLWQA 294245708501143	Total Coliform	6/19/03	1
	21FLWQA 294247208500491	Total Coliform	6/19/03	1
	21FLWQA 294300108459147	Total Coliform	6/19/03	1
	21FLWQA 294316008458500	Total Coliform	6/19/03	1
375A (Scipio Creek)	21FLPNS AR26	Fecal Coliform	11/12/96 – 3/3/98	9
	21FLPNS AR27	Fecal Coliform	11/12/96 – 3/3/98	9
	21FLPNS GC23	Fecal Coliform	11/12/96 – 3/3/98	9
	21FLPNS LSM31	Fecal Coliform	11/12/96 – 3/3/98	8
	7545 (AR45)	Fecal Coliform	12/15/03	1
	7550 (AR50)	Fecal Coliform	11/17/03 - 12/15/03	2
	7551 (SC5)	Fecal Coliform	12/15/03	1
	7554 (SC10)	Fecal Coliform	11/17/03 - 12/15/03	2
	7555 (AR55)	Fecal Coliform	12/15/03	1
	7556 (SC20)	Fecal Coliform	11/17/03 - 12/15/03	2
	7560 (AR60)	Fecal Coliform	11/17/03 - 12/15/03	2
	9000 (AB3)	Fecal Coliform	6/19/03	1
	SC08 (mouth of Scipio Cr)	Fecal/Total Coliform	4/20/04 – 5/22/04	10
375B (Apalachicola R)	21FLPNS AR20	Fecal Coliform	11/12/96 – 3/3/98	9
	21FLPNS AR22	Fecal Coliform	11/12/96 – 3/3/98	9
	21FLPNS LSM33	Fecal Coliform	11/12/96 – 3/3/98	7
	21FLPNS SMR35	Fecal Coliform	11/12/96 – 3/3/98	9
	AR02 (above confluence with Jackson River)	Fecal/Total Coliform	4/20/04 – 5/22/04	10
272 (Thompson Pond)	Thompson Pond Ditch at McKinnie Rd	Fecal Coliform	12/15/03	1
	Thompson Pond Ditch at Salem Church Rd	Fecal Coliform	12/15/03	1
	TP10 (end of dock)	Fecal/Total Coliform	4/20/04 – 5/22/04	10
175 (Muddy Branch)	21FLBFA 31020021	Fecal/Total Coliform	2/4/96 – 5/4/97	5
	Muddy Br. @ SR 167 (5510)	Fecal/Total Coliform	11/18/03 – 12/15/03	2

WBID	Station Name	Parameter Evaluated	Available Sampling Period	Number Samples
	Muddy Br. @ Blue Hole Rd (Cavern St Park 5520)	Fecal/Total Coliform	11/18/03 – 12/15/03	2
	MC06 (inside Florida Caverns State Park)	Fecal/Total Coliform	4/20/04 – 5/22/04	10
	MC07 (at SR 167)	Fecal/Total Coliform	4/20/04 – 5/22/04	10
1286 (Huckleberry Cr)	21FLPNS HC21D	Total Coliform	2/10/97 – 3/3/98	8
	21FLWQA 294405308504411	Total Coliform	6/17/03	1
	21FLWQA 294423208504412	Total Coliform	6/17/03	1
	21FLWQA 294448308504319	Total Coliform	6/17/03	1
	Huckleberry Cr @ Moses Rd (HC04, HC7)	Total Coliform	11/17/03 – 5/22/04	12
	Huckleberry Cr @ confluence with Jackson River (HC05)	Total Coliform	4/20/04 – 5/22/04	10
	Huckleberry Cr @ RR near Teats Rd (HC10, HC9.9)	Total Coliform	11/17/03 – 12/15/03	4
	Huckleberry Cr @ Teats Dock (HC25)	Total Coliform	11/17/03 – 12/15/03	2
	Huckleberry Cr (HC50, HC40)	Total Coliform	11/17/03 – 12/15/03	4
	Huckleberry Cr ~ 150yds from mouth (HC70)	Total Coliform	11/17/03 – 12/15/03	2

Table 4. Summary of Fecal Coliform Monitoring Data and Class III Criteria

WBID	Number of Samples	30-Day Geometric Mean ¹	% Samples > 400 (MPN/100mL)	% Samples > 800 (MPN/100mL)	Minimum Concentration (MPN/100mL)	Maximum Concentration (MPN/100mL)
175	29	95 (MC07)	14%	6.9%	1	1600

Table 5. Summary of Fecal Coliform Monitoring Data and Class II Criteria

WBID	Number of Samples	Median (MPN/100ml)	% Samples > 43 (MPN/100mL)	% Samples > 800 (MPN/100mL)	Minimum Concentration (MPN/100mL)	Maximum Concentration (MPN/100mL)
1274						
375A	53	66	50%	0	6	320

Table 6. Summary of Total Coliform Monitoring Data and Class III Criteria

WBID	Number of Samples	30-Day Geometric Mean	% Samples > 2,400 (MPN/100mL)	Minimum Concentration (MPN/100mL)	Maximum Concentration (MPN/100mL)
1286	43	5543 (HC05)	54%	70	80,000
375B	44	5498 (AR02)	18%	20	16,000
272	12	3784 (TP10)	58%	660	8067
175	29	8983 (MC07)	18%	1	59,000

Violations of fecal and total coliform criteria often occur in response to rainfall events. The National Oceanic and Atmospheric Administration (NOAA) collect meteorological data at numerous locations in Florida. Precipitation data collected at stations near the impaired WBIDs are superimposed on the water quality results to identify conditions when violations are occurring. Figure 2 shows the correlation between total coliform measured in WBID 375B and precipitation measured at the Apalachicola Airport. This figure indicates coliform violations occur during dry conditions. The correlation between rainfall and coliform in other impaired WBIDs are shown in Appendix A.

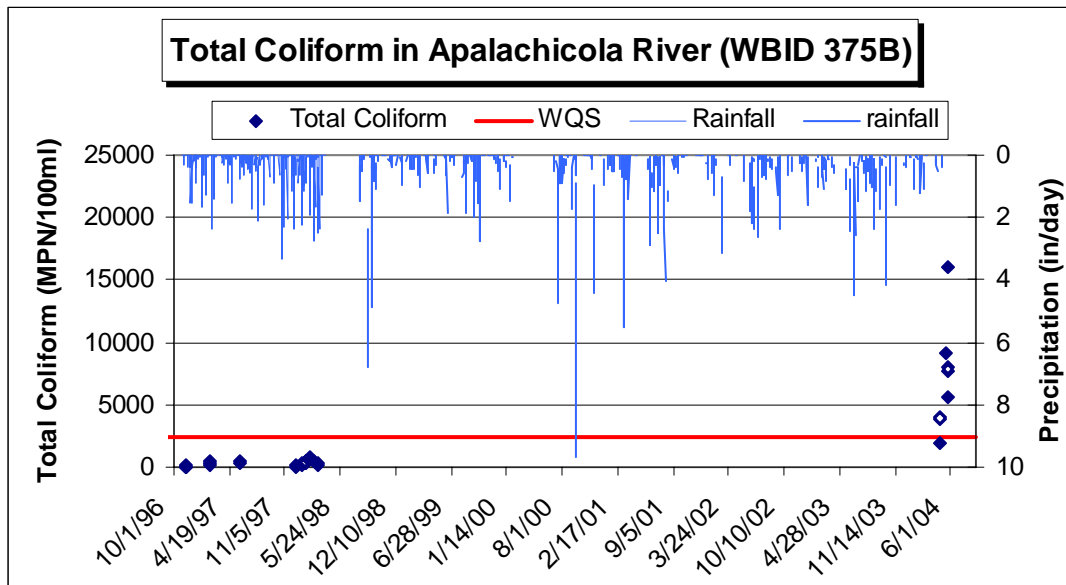


Figure 2. Correlation between total coliform in Apalachicola River and precipitation

5.2 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of coliform bacteria in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of coliform.

Non-point sources of coliform are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of bacteria on land surfaces and wash off as a result of storm events. Typical non-point sources of coliform include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Boat Traffic and Marinas
- Urban development (outside of Phase I or II MS4 discharges)

The Watershed Characterization System (WCS), a geographic information system (GIS) tool, was used to display, analyze, and compile available information to characterize potential bacteria sources in the impaired watersheds. This information includes land use categories, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

5.2.1 Point Sources

There are several point sources located in the drainage areas of the 303(d) listed stream segments that possess NPDES permits for discharges of treated sanitary wastewater; however, most of these facilities discharge to percolation ponds, spray fields, or deep injection wells. A wasteload allocation (WLA) is given only to NPDES facilities discharging to surface waters. A review of permit conditions provided in EPA's Permit Compliance System (PCS) database (www.epa.gov/enviro) indicates domestic facilities have permit limits for fecal coliform bacteria and not total coliform bacteria. There are no facilities discharging directly into the impacted WBIDs. It should be noted that wastewater facilities permits authorize a discharge only if the applicant provides reasonable assurance that the discharge will not cause or contribute to violations of the water quality criteria.

There were two NPDES permitted point sources considered in the modeling effort for Apalachicola Bay. The City of Apalachicola WWTP (FL0038857) and City of East Point land application system, located on the peninsula between East Bay and St George Bay. The WWTP has several lift stations within the City of Apalachicola of which, four are along the waterfront with the potential for direct impact on water quality in Apalachicola Bay. The plant upgraded to tertiary treatment in 2002 with the objective of correcting problems with inflow/infiltration. DMR data from the WWTP expressed only that effluent concentration of fecal coliform was at all times less than or equal to 2 MPN/100 mL. There were no data available for the land application system, so the assumption was made that it did not discharge fecal coliform to surface waters.

Municipal Separate Storm Sewer Systems (MS4s) may also discharge bacteria to waterbodies in response to storm events. Currently, large and medium MS4s serving populations greater than 100,000 people are required to obtain a NPDES storm water permit. In March 2003, small MS4s serving urbanized areas will be required to obtain a permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile. The stormwater collection systems owned and operated by the City of Apalachicola is not currently covered by an MS4 permit.

5.2.2 Non-point Sources

5.2.2.1 Wildlife

Wildlife deposit bacteria with their feces onto land surfaces where it can be transported during storm events to nearby streams. The bacteria load from wildlife is assumed background, as the

contribution from this source is small relative to the load from urban and agricultural areas. In addition, any strategy employed to control this source would probably have a negligible impact on obtaining water quality standards.

5.2.2.2 Agricultural Animals

Agricultural animals are the source of several types of coliform loadings to streams. Agricultural activities impacting water quality include runoff from pastureland and cattle in streams. Livestock inventory from 2002 Census of Agriculture for the counties encompassing the impaired WBIDs are listed in Table 7. Agricultural activities are primarily in Jackson County. Cattle, including beef and dairy cows, is the predominate livestock.

The Florida Department of Agriculture and Consumer Services (FDACS), Office of Agricultural Water Policy developed a manual outlining best management practice for cow/calf operations (FDACS, 1999). In this report the authors state “implementation of the practices described in this manual provides a good argument that you have made reasonable efforts to reduce pollutants from your ranch by the maximum practicable amount”. The manual acknowledges “after implementation of these BMPs it may be necessary to add more stringent guidelines for site specific areas that continue to exceed water quality standards”.

Table 7. Livestock Inventory by County (source: NASS, 2002)

Livestock (inventory)	Franklin	Jackson
Cattle and calves	(D)	35,708
Beef Cows	(D)	17,878
Dairy Cows	(D)	2,387
Swine		1,532
Poultry (broilers sold)	---	(D)
Sheep	---	109
Goats	---	1,780
Horses and Ponies	---	1,387

Notes: (D) – data withheld to avoid disclosing data for individual farms

5.2.2.3 Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water.

The State of Florida Department of Health (www.doh.state.fl.us/environment/statistics) publishes septic tanks data on a county basis. Table 8 summarizes the number of septic systems installed

since the 1970 census and the total number of repair permits issued between 1996 and 2001. The data does not reflect septic tanks removed from service.

Table 8. County Estimates of Septic Tanks and Repair Permits (FDEP, 2001)

County	Number of Septic Tanks (2002)	Number of Repair Permits Issued (1996 – 2002)
Franklin	4,630	325
Jackson	15,704	812

5.2.2.4 Boat Traffic and Marinas

Boat traffic may contribute metals including copper, tin and lead, as well as petroleum and occasional discharges of raw or partially treated sewage. Marinas are recognized pollution sources and as a result several states, including Florida, prohibit shellfishing in the vicinity of marinas. Marinas are located in the Scipio Creek basin. Marinas typically use septic systems to dispose of domestic waste.

Both commercial and recreational boating occurs within shellfish harvesting waters of Apalachicola Bay (WBID 1274). There are no mass harborage areas, which could adversely impact shellfish harvesting waters. Boat traffic occurring in Apalachicola Bay is not considered a significant contributor of fecal coliform to the bay.

5.2.2.5 Urban Development

Fecal coliform loading from urban areas is attributable to multiple sources including storm water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C.

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5)(c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's stormwater programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of NPS pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing impervious surfaces. Technology-based structural BMPs are used to mitigate the increased stormwater peak discharge rate, volume, and pollutant loadings that accompany

urbanization.

5.3 Analytical Approach

The approach for calculating coliform TMDLs depends on the number of water quality samples and the availability of flow data. When long-term records of water quality and flow data are not available, the TMDL is expressed as a percent reduction. When limited water quality or flow data are available a mass balance approach is used to calculate the TMDL. Load duration curves are used to develop TMDLs in freshwaters when significant data are available to develop a relationship between flow and concentration. For complex waterbodies such as the Apalachicola Bay, a numerical model was developed to estimate the loads. For the load duration curve TMDLs, the target is the acute criteria. The approach and the target used to develop the coliform TMDLs are listed in Table 9. Details pertaining to the analytical approach are included in Appendix B.

Table 9. Approach for developing coliform TMDLs

Listed Waterbody	Parameter	Approach
Apalachicola Bay (1274)	Fecal and Total Coliform	EFDC Model
Apalachicola Bay (1274B)	Total Coliform	EFDC Model
Scipio Creek (375A)	Fecal and Total Coliform	EFDC Model
Apalachicola River (375B)	Total Coliform	EFDC Model
Huckleberry Creek (1286)	Total Coliform	Load Duration Curve
Thompson Pond (272)	Total Coliform	Percent Reduction
Muddy Branch (175)	Fecal and Total Coliform	Percent Reduction

5.3.1 Percent Reduction Approach for TMDL Development

The TMDLs for Thompson Pond, and Muddy Branch are expressed as percent reductions necessary to reduce instream concentrations to water quality criteria. This approach is appropriate as a means for estimating flow at the time of sampling in Thompson Pond and Muddy Branch are not available. Existing conditions in these WBIDs are based on the maximum concentration violating the target. If sufficient data are available to calculate the geometric mean concentration (i.e., 10 samples in 30 days), the reduction to the geometric mean criteria is also calculated. The reduction resulting in the highest value is used to represent the TMDL.

5.3.2 Mass Balance Approach for TMDL Development

Load duration curves are based on the conservation of mass principle as defined in Equation 1.

$$\text{Load} = \text{Concentration} * \text{Flow} * \text{Conversion Factor} \quad (\text{Equation 1})$$

Where:

- Load = MPN/day
- Flow = cfs
- Concentration = MPN/100mL
- Conversion Factor = (28.247 L/cf * 86400 sec/day * 1000mL/L)/100mL

For existing conditions, the sample concentration and an estimate of flow on the day of sampling is used to calculate the load. The allowable load, or TMDL, is calculated using the applicable water quality criterion. If a USGS flow gage operates in the WBID a flow duration curve is developed and the flow at various duration intervals is used to estimate the allowable load. Flows on ungaged streams can be extrapolated using a drainage area ratio or some type of regression analysis. The drainage area method is appropriate to estimate flows when the drainage area for the ungaged site is within about 0.5 to 1.5 times the drainage area of the gaged site (personal communications, USGS, 2002). When the locations of the monitoring stations and flow gage do not coincide, flows at the monitoring stations are estimated based on the drainage area ratio of the two sites.

5.3.3 Flow Duration Curves

The first step in developing load duration curves is to create flow duration curves. A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The curve relates flows measured at a monitoring station to a duration interval representing the percent of time flows are equaled or exceeded. Flows are ranked from low, which are exceeded nearly 100 percent of the time, to high, which are exceeded less than 1 percent of the time. Flow duration curves are limited to the period of record available at a gage. The confidence in the duration curve approach in predicting realistic percent load reductions increases when longer periods of record are used to generate the curves.

Florida DEP developed a fecal coliform TMDL for Huckleberry Creek based on the load duration curve technique. The total coliform TMDL described in this document is based on the flow duration curve developed in the FDEP TMDL. Flows in Huckleberry Creek are based on a weighted drainage area ratio with the USGS gage on Telogia Creek (USGS 02330100). The flow duration curve for Huckleberry Creek is shown in Figure 3.

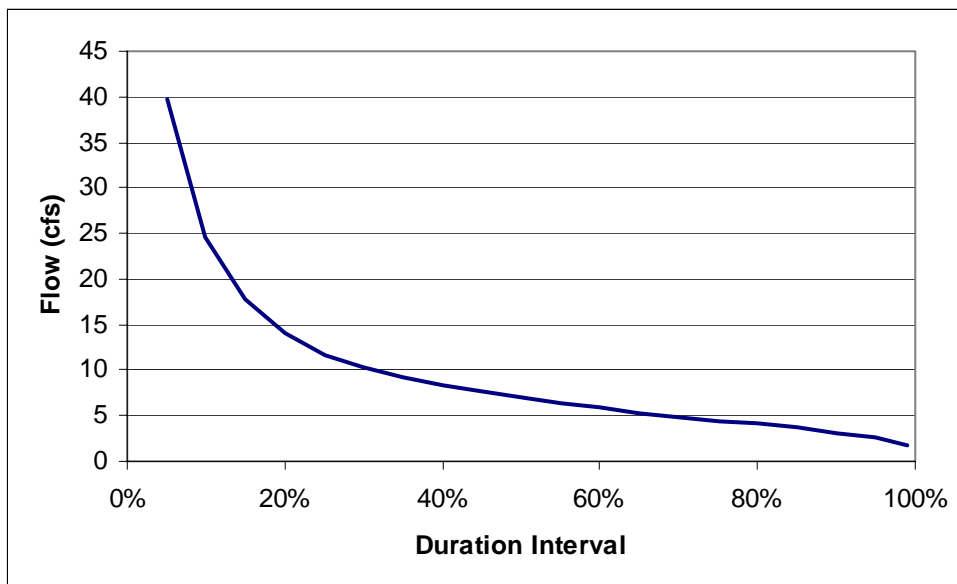


Figure 3. Flow Duration Curve for Huckleberry Creek (estimated)

5.3.4 Load Duration Curves

Flow duration curves are transformed into load duration curves by multiplying the flow values at each duration interval by the appropriate water quality criterion and a conversion factor. The line through these points is called the target line. Each point on this line represents the allowable load, or TMDL, at each interval. Existing loads are superimposed on the curve based on the duration interval of the flow used to calculate the existing load. Existing loads that plot above the target line indicate a violation of water quality criterion, while loads plotting below the line represent compliance. The load duration curve for total coliform in Huckleberry Creek is shown in Figure 4.

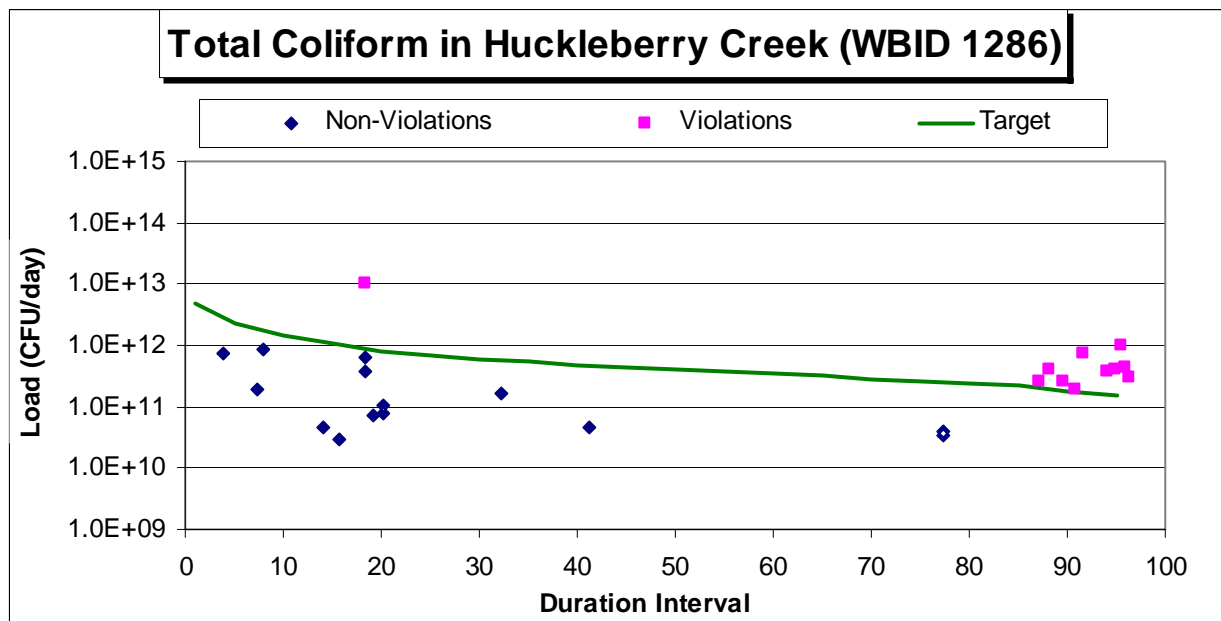


Figure 4. Load Duration Curve for Total Coliform in Huckleberry Creek (WBID 1286)

The positioning of monitoring data on the load duration curve provides an indication of the potential sources and delivery mechanisms of the pollutant. In general, violations occurring on the right side of the curve typically occur during low flow events and are indicative of continuous pollutant sources, such as NPDES permitted discharges, leaking collection lines, or leaking septic systems. Livestock having access to streams could also be a source during low flow (livestock are not expected to be in the stream during high flows). Violations that occur on the left side of the curve occur during high flow events. Violations in this range are indicative of sources responding to rainfall events. As shown in Figure 4, water quality violations occur during dry conditions (i.e., flows exceeded between 60 and 90 percent of time) or after rainfall events preceded by an extended dry period.

Flow duration curve intervals can be grouped into broad categories, or zones, in order to provide

insight about conditions and patterns associated with the impairment (Cleland, 2003). In these TMDLs, load duration curves are divided into five zones: one representing high flows, another for moist conditions, one covering median or mid-range flows, another for dry conditions, and one representing low flows. The use of duration curve zones provides a method for communicating technical information in a way that easily conveys conditions associated with problems.

If a sufficient number of samples plot above the allowable load line (i.e., more than four points), a trendline is drawn through the data violations. In the load curve application, trend lines are used to predict the load at other duration intervals. The type of line drawn through the data can have several shapes, ranging from linear (simplest form) to moving average. The type of the line chosen should result in a relatively high correlation factor, denoted by the variable R^2 . The correlation factor provides an indication of how well the equation of the line represents the data. In general, high correlation factors are not associated with environmental data.

5.3.5 EFDC Modeling Approach to TMDL Analysis

The Environmental Fluid Dynamic Code (EFDC) model was used to develop the fecal and total coliform TMDLs for the Apalachicola Bay and Apalachicola River – Scipio Creek WBIDs. This model was selected as it has the capability of simulating the complex circulation in tidal waterbodies, including the density effects of salinity. The EFDC model takes pollutant loads from the various sources and through meteorological forcing functions simulates the advective transport and dispersion of the input loads. Attenuation of coliform loads was simulated by a first-order exponential decay. A general description of the model development and calibration follows; details on the model can be found in Appendix C.

A model grid was constructed covering all of the listed reaches along with those stream sections required to provide overall connectivity between the listed segments and tributary inputs. The model included 737 grid cells, each with two vertical layers. The grid covers the shellfish harvesting areas in the bay. When available, observed fecal coliform concentrations were used to set fresh water boundary conditions.

The calibration process was simplified to accommodate the limited resources and data. The calibration was focused in two areas: 1) flushing and 2) water quality. Streamflow data collected at a USGS gage located on Apalachicola River (USGS 02359170) were used to calibrate hydrologic conditions in the riverine portion of the model. The tidal exchange rate calculated for Apalachicola Bay was used to calibrate hydrologic conditions in the estuary and bay portions of the model. The year 1997 was chosen to determine TMDL and allocation scenarios because it was representative of the daily average flow values covering both higher and lower flow periods.

According to the 1997 Shellfish Harvesting Survey conducted by FDEP, Apalachicola Bay is in an area of transition between the semi-diurnal tides of southwestern Florida and the diurnal tides of northwestern Florida. Based on the mean low tide average depth within the bay, and the mean tidal prism, there is a calculated exchange of 17 percent of bay water volume twice daily (FDEP, 1997). The hydrodynamic component of the model was calibrated at the grid cell representing NOAA Apalachicola station (8728690). The tidal exchange rate calculated using model output was 17.5 percent, and compares favorably with the flushing rate in the bay. A comparison of simulated and observed tidal fluctuations for the calibration period are shown graphically in Appendix C.

The coliform calibrations were challenged by limited data. As such, it was more reasonable to simulate relative magnitudes than to match observed data on specific dates. A prominent station for gaging calibration in Apalachicola Bay was 21FLA 16270SEAS. This station is located in the upper middle portion of WBID 1274, near the mouth of Apalachicola River, and is used for shellfish classification and compliance by FDACS. In the riverine segments of the model, water quality calibration was evaluated at stations in WBIDs 375A and 375B. Calibration plots of simulated and observed concentrations are shown in Appendix C. These plots indicate that the model is reasonably representing the observed fecal coliform concentrations.

Once the model was calibrated, reductions were made to model inputs until simulated concentrations at the calibration stations no longer exceeded the target concentrations. Once reductions had been calculated it was necessary to assure simulated bacteria concentrations in the Bay achieve Class II water quality criteria at all stations used by FDACS to monitor shellfish classification and compliance.

5.4 Development of Total Maximum Daily Loads

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. TMDLs for the impaired waterbodies are expressed in terms of a percent reduction, and where possible, as loads in units of counts per day. When expressed as a load, the TMDL value represents the maximum one-day load the stream can transport over a 30-day period and maintain water quality standards.

5.4.1 Critical Conditions

The critical condition for non-point source coliform loading is typically an extended dry period followed by a rainfall runoff event. During the dry weather period, coliforms build up on the land surface, and are washed off by rainfall. The critical condition for point source loading occurs during periods of low stream flow when dilution is minimized. Water quality data have been collected during both time periods. Most violations occur during median to high flow conditions.

Critical conditions are accounted for in the load curve analysis by using the entire period of record of measured flows and all water quality data available for the stream. The critical condition is defined as the zone requiring the largest reduction. By achieving the reduction of the critical zone, water quality standards should be achieved during all other time periods.

5.4.2 Existing Conditions

Existing conditions are based on the instream water quality violations. When only a few samples exceed the numerical criterion, existing loads are based on the average values of the violations occurring in each zone. The trend line equation is also used to calculate the existing load at each duration interval. If water quality violations occur over several zones, the loads between the 10th and 90th duration interval were averaged to obtain a single value. Flows occurring less than 10 percent of the time were considered extreme flood conditions while flows occurring greater than 90 percent of the time were considered extreme drought conditions. Extreme flow conditions were not considered in the TMDL analysis unless these were the only violations measured in the WBID.

It was not possible to construct a trend line through the limited data violations in Huckleberry Creek (see Figure 4); therefore, the existing load was estimated based on the average concentration of the data violations or 4.89×10^{11} cfu/day. Details on this calculation as well as calculations of existing loads for the other impaired streams are provided in Appendix B.

In the EFDC model, existing loads for the listed segments are represented as the sum of the daily discharge load of the direct point sources, and the daily indirect load from all land uses (e.g., surface runoff) for calendar year 1997. The baseline conditions allow for an evaluation of instream water quality under critical conditions.

5.5 Margin of Safety

There are two methods for incorporating a MOS in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. An explicit MOS was used in the Apalachicola–Chipola Basin TMDLs. For TMDLs developed using load curves, the assumption that the highest reduction in the five zone results in percent reductions higher than what is required based on observed data violations. In the mass balance approach, the maximum concentration measured instream is used in the calculations and this results in a conservative estimate of the reduction needed to attain standards.

In the EFDC model of Apalachicola Bay an explicit margin of safety was incorporated in the model by reducing coliform criteria by 10 percent. For Class II criteria the fecal and total coliform targets were 38.7 MPN/100mL and 207 MPN/100mL, respectively.

5.5.1 Determination of TMDL, WLAs, & LAs

The TMDL represent the maximum daily load the stream can assimilate and maintain water quality standards. The TMDLs are based on the one-day maximum concentration of the parameter as specified in the standards. When it is possible to estimate flow at the time samples were collected, the TMDL is expressed in units of cfu per day, otherwise the TMDL is expressed as a percent reduction necessary to achieve the target criteria. The TMDL value is reduced by the WLA, if any, to obtain the LA component. TMDL components for the impaired WBIDs as well as the percent reduction required to achieve the numerical criterion are provided in Table 10 and Table 11.

Table 10. Fecal Coliform TMDL Components

Stream Name	WLA ¹		LA (cfu/day)	TMDL ³ (cfu/day)	Percent Reduction ³
	Continuous (cfu/day)	MS4 (reduction)			
Apalachicola Bay (WBID 1274)	5.44×10^9	N/A	4.94×10^{13}	4.94×10^{13}	0 (see note 4)
Apalachicola River- Scipio Creek (WBID 375A)	5.44×10^9	N/A	4.94×10^{13}	4.94×10^{13}	30% (see note 5)
Muddy Branch (WBID 175)	N/A	N/A	5.04×10^9	5.04×10^9	50%

Notes:

1. WLA component separated into load from continuous NPDES facilities (e.g., WWTP) and load from MS4. Continuous discharge facilities have WLA units of counts/day based on permit limits and design flow.
2. N/A = not applicable
3. Margin of Safety is implicit and does not add to the TMDL value.
4. Proposed reductions in the Apalachicola River should result in attainment of standards in WBID 375A and Apalachicola Bay.
5. Proposed reduction required from area discharging into WBID 375A

Table 11. Total Coliform TMDL Components

WBID	WLA _{Continuous}	WLA _{MS4} (reduction)	LA (cfu/day)	TMDL (cfu/day)	Reduction (to nonpoint sources)
1286	N/A	N/A	1.51×10^{11}	1.51×10^{11}	82%
1274	N/A	N/A	2.70×10^{14}	2.70×10^{14}	See note 2
1274B	N/A	N/A	2.70×10^{14}	2.70×10^{14}	See note 2
375A	N/A	N/A	2.70×10^{14}	2.70×10^{14}	See note 2
375B	N/A	N/A	2.70×10^{14}	2.70×10^{14}	15%
272	N/A	N/A	74% reduction	74% reduction	74%
175	N/A	N/A	3.02×10^{10}	3.02×10^{10}	96%

Note:

1. N/A = not applicable
2. Reductions proposed for WBID 375B should result in attainment of standards in WBID 375A and Apalachicola Bay

5.5.2 Waste Load Allocations

The NPDES facilities located in the Apalachicola–Chipola Basin with coliform permit limits discharge to spray fields. Only facilities discharging directly into streams and MS4 areas are assigned a WLA. The WLAs, if applicable, are expressed separately for continuous discharge facilities (e.g., WWTP) and MS4 areas as the former discharges during all weather conditions whereas the later discharges in response to storm events.

The City of Apalachicola WWTP has lift stations located in WBID 375A that pump the wastewater to the facility in the Huckleberry Creek watershed (WBID 1286). This facility does not have permit

limits for total coliform and is not assigned a WLA. . In terms of fecal coliform, the DMR data expressed only that the discharge concentration was at all times less than or equal to 2 MPN/100 mL. DMR discharge data and a fecal coliform concentration of 2 MPN/100mL were used in the model to estimate the WLA from the WWTP (see Appendix C). Based on DMR data, flow path, and magnitude of the WLA, The TMDLs for Apalachicola Bay do not require reductions from this facility. Compliance with permit limits are expected to be maintained.

5.5.3 Load Allocations

There are two modes of transport for non-point source fecal coliform bacteria loading into the stream. First, loading from failing septic systems and animals in the stream are considered direct sources to the stream, as they are independent of precipitation. The second mode involves coliform loadings resulting from accumulation on land surfaces transported to streams during storm events.

The positioning of the water quality data values on the load duration curve provide an indication of the mode of transport occurring during periods of violations. For the impaired WBIDs in the Apalachicola-Chipola Basin, most violations are distributed on the right side of the curve, indicating violations occur during low flow conditions. The LA components represented in Table 10 are calculated as the difference between the TMDL and the WLA components.

The loading reductions necessary to meet the TMDL for Apalachicola Bay were achieved by eliminating nonpoint source fecal coliform runoff by 30 percent and total coliform runoff by 15 percent. Nonpoint coliform sources may include urban runoff, agricultural activity runoff, septic tanks, marine activities, etc.

5.5.3 Calculation of Percent Reduction

The percent reduction necessary to achieve water quality standards is based on the more stringent of the dual acute criteria (i.e., 400 MPN/100ml). If sufficient data are available to calculate the reduction using the chronic criteria (i.e., geometric mean), the larger value calculated using the acute and chronic criteria is selected for the TMDL. Calculations of the TMDL and percent reductions for the coliform TMDLs are provided in Appendix B; an example using the total coliform TMDLs for Huckleberry Creek is explained below.

The total coliform TMDL for Huckleberry Creek was developed using a load duration curve. Violations were separated into zones of impairment as defined in Section 5.3.3. When multiple violations occur within a zone, the existing load is calculated as the average of the load violations. The TMDL value is the allowable load at the midpoint of the zone. If one violation defines a zone, the TMDL value equals the allowable load at the interval where the violation occurs. The TMDL zones and reductions required to attain standards in Huckleberry Creek are shown in Table 12.

Table 12. Calculation of TMDL and reductions by zone for Huckleberry Creek (WBID 1286)

Zone Approach for fecal coliform:					
a) Existing Loads expressed as cfu/day (average violation in each zone); TMDL is midpoint in range					
	High (0-10)	Moist (10-40)	Mid-Range (40-60)	Dry (60-90)	Low (90-100)
TMDL	2.34E+12	8.19E+11	4.09E+11	2.62E+11	1.51E+11
Existing		1.03E+13		3.07E+11	4.89E+11
% Redux (acute)		92.1		14.6	69.2
% Redux (chronic):		82.0%			
Note: Chronic reduction based on existing geometric mean concentration of 5543 MPN/100ml and water quality criteria of 1000 MPN/100ml					

Only nonpoint sources contribute total coliform load in Huckleberry Creek. If a NPDES continuous discharge facility is in the WBID a WLA would be assigned to the facility. The WLA value is subtracted from the TMDL load to obtain the LA component. The MOS is assumed implicit in the analysis and does not impact the values assigned to the loads. TMDL components for Huckleberry Creek are shown in Table 13.

Table 13. TMDL Components for Huckleberry Creek (WBID 1286)

TMDL	1.51 x 10 ¹¹ cfu/day
WLA (continuous discharge)	Not applicable
WLA (MS4 discharge)	Not applicable
LA	1.51 x 10 ¹¹ cfu/day
MOS	Implicit
Percent Reduction	82%

5.5.4 Seasonal Variation

Seasonal variation was incorporated in the load curves by using the entire period of record of flow recorded at the gages. Seasonality was also addressed by using all water quality data associated with the impaired WBIDs, which was collected during multiple seasons.

5.6 Recommendations

Determining the source of bacteria in waterbodies is the initial step to implementing a coliform TMDL. FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the necessary load reductions. Components of a B-MAP are:

- Allocations among stakeholders
- Listing of specific activities to achieve reductions
- Project initiation and completion timeliness
- Identification of funding opportunities
- Agreements
- Local ordinances
- Local water quality standards and permits
- Follow-up monitoring

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APPENDIX A WATER QUALITY DATA

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Table A- 1. Guide to Water Quality Remark Codes (Rcode column in data tables)

Remark Code	Definition	Use in TMDL
A	Value reported is mean of two or more samples	Data included in analysis as reported
B	Result based on colony counts outside the acceptable range	Data not included in analysis as reported
E	Extra sample taken in compositing process	Data included as average
I	The value reported is less than the practical quantification limit and greater than or equal to the method detection limit.	Data included in analysis as reported
K	Off-scale low. Actual value not known, but known to be less than value shown	Data included in analysis as reported
L	Off-scale high. Actual value not known, but known to be greater than value shown	Data included in analysis as reported
Q	Sample held beyond normal holding time	Data not used in analysis
T	Value reported is less than the criteria of detection	Data included in analysis if the reported value is below criteria; otherwise, reported value is not used in the analysis
U	Material was analyzed for but not detected. Value stored is the limit of detection.	Data not included in analysis
<	NAWQA – actual value is known to be less than the value shown	Data included in analysis

Table A- 2. Fecal coliform data collected in Muddy Branch (WBID 175)

Date	Station	Time	Depth	Result	Rcode
1/13/93	112WRD 305109085103700	1130	.	1200	>
4/12/93	112WRD 305109085103700	1300	.	240	>
7/22/93	112WRD 305109085103700	1120	.	10000	E
8/7/94	21FLBFA 31020021	930	1.00	200	Q
11/6/94	21FLBFA 31020021	1151	1.00	2400	Q
2/5/95	21FLBFA 31020021	1245	1.50	80	Q
5/7/95	21FLBFA 31020021	1220	0.50	10	U
2/4/96	21FLBFA 31020021	1100	1.00	1	Z
5/5/96	21FLBFA 31020021	1150	1.00	30	Q
11/3/96	21FLBFA 31020021	1205	1.00	20	Q
2/16/97	21FLBFA 31020021	1200	0.50	400	Q
5/4/97	21FLBFA 31020021	1102	1.00	1400	Q
11/18/03	5510 'MUDDY BRANCH AT SR 167	1019	0.5	410	Q
12/15/03	5510 'MUDDY BRANCH AT SR 167	945	0.5	100	Q
12/15/03	5520 'MUDDY BRANCH AT BLUE HOLE RD (CAVERNS STATE PARK)	1050	0.5	84	Q
11/18/03	5520 'MUDDY BRANCH AT BLUE HOLE RD (CAVERNS STATE PARK)	1049	0.5	6	BQ

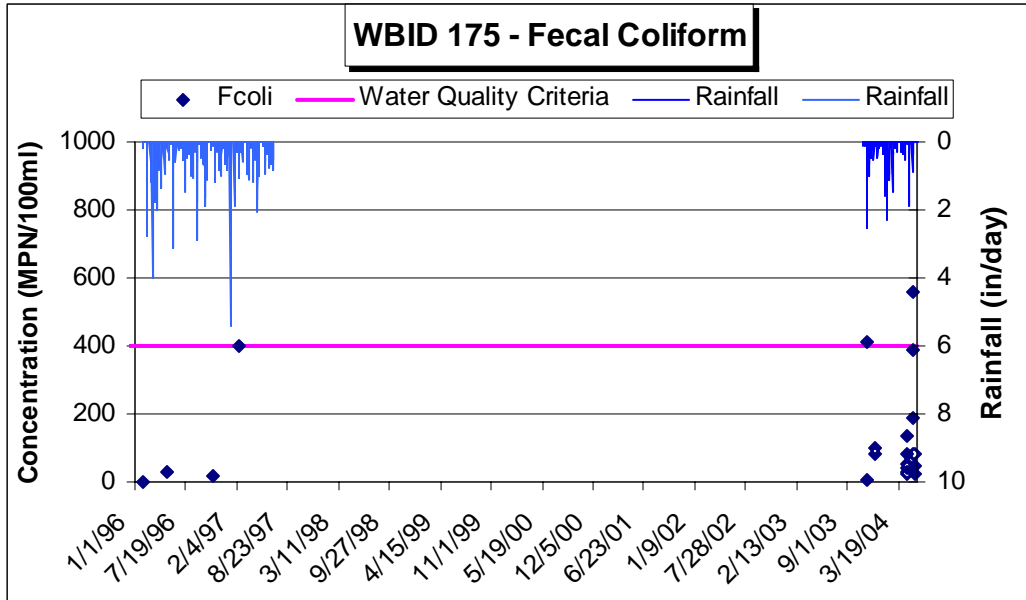


Figure A- 1. Fecal coliform measurements in Muddy Branch (WBID 175)

Note: water quality data plotted on log scale to illustrate data variability

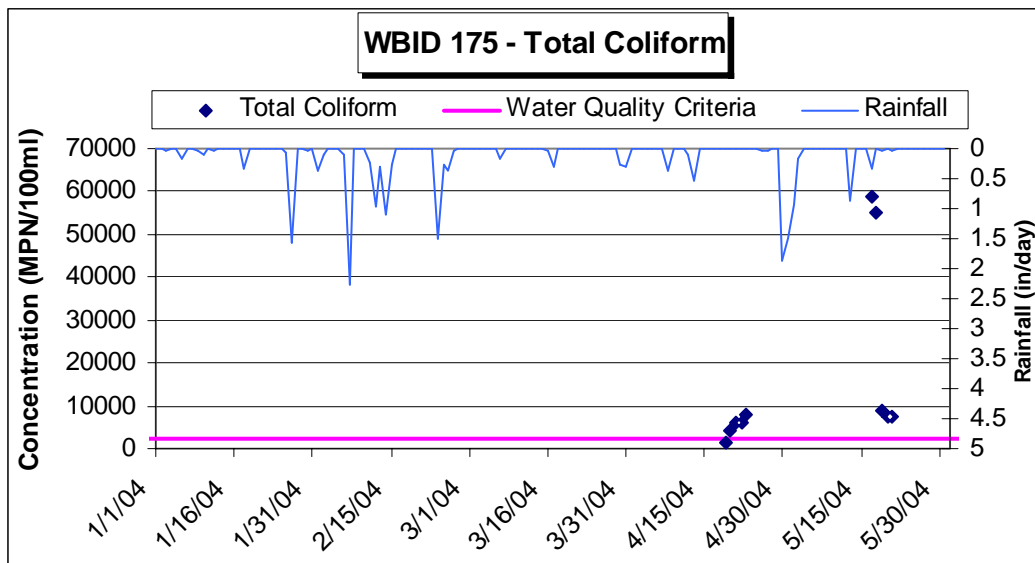


Figure A- 2. Total coliform measurements in Muddy Branch (WBID 175) and precipitation collected at Shipley 3E meteorological gage

Table A- 3. Total Coliform Data Collected in Muddy Branch (WBID 175)

Date	Station	Time	Depth	Result	Rcode
2/4/96	21FLBFA 31020021	1100	1.00	1	Z
5/5/96	21FLBFA 31020021	1150	1.00	400	Q
11/3/96	21FLBFA 31020021	1205	1.00	320	Q
2/16/97	21FLBFA 31020021	1200	0.50	1500	Q
5/4/97	21FLBFA 31020021	1102	1.00	5	Z
11/18/03	5510 'MUDDY BRANCH AT SR 167	1019	0.5	760	BQ
12/15/03	5510 'MUDDY BRANCH AT SR 167	945	0.5	330	Q
4/19/04	Muddy Branch at SR 167 (MC07)	1545		1600	>
4/20/04	Muddy Branch at SR 167 (MC07)	1130		4100	
4/21/04	Muddy Branch at SR 167 (MC07)	1020		6300	QC
4/22/04	Muddy Branch at SR 167 (MC07)	950		6300	
4/23/04	Muddy Branch at SR 167 (MC07)	1030		8000	>
5/17/04	Muddy Branch at SR 167 (MC07)	1538		59000	
5/18/04	Muddy Branch at SR 167 (MC07)	958		55000	
5/19/04	Muddy Branch at SR 167 (MC07)	1030		9000	
5/20/04	Muddy Branch at SR 167 (MC07)	950		7600	
5/21/04	Muddy Branch at SR 167 (MC07)	959		7400	
12/15/03	5520 'MUDDY BRANCH AT BLUE HOLE RD (CAVERNS STATE PARK)	1050	0.5	380	Q
11/18/03	5520 'MUDDY BRANCH AT BLUE HOLE RD (CAVERNS STATE PARK)	1049	0.5	100	BQ
4/19/04	Muddy Branch inside Florida Caverns State Park (MC06)	1510		1600	>
4/20/04	Muddy Branch inside Florida Caverns State Park (MC06)	1112		5700	
4/21/04	Muddy Branch inside Florida Caverns State Park (MC06)	1005		4000	
4/22/04	Muddy Branch inside Florida Caverns State Park (MC06)	938		6400	
4/23/04	Muddy Branch inside Florida Caverns State Park (MC06)	940		5600	
5/17/04	Muddy Branch inside Florida Caverns State Park (MC06)	1520		18600	
5/18/04	Muddy Branch inside Florida Caverns State Park (MC06)	936		5467	
5/19/04	Muddy Branch inside Florida Caverns State Park (MC06)	958		7200	
5/20/04	Muddy Branch inside Florida Caverns State Park (MC06)	935		8667	
5/21/04	Muddy Branch inside Florida Caverns State Park (MC06)	925		7533	

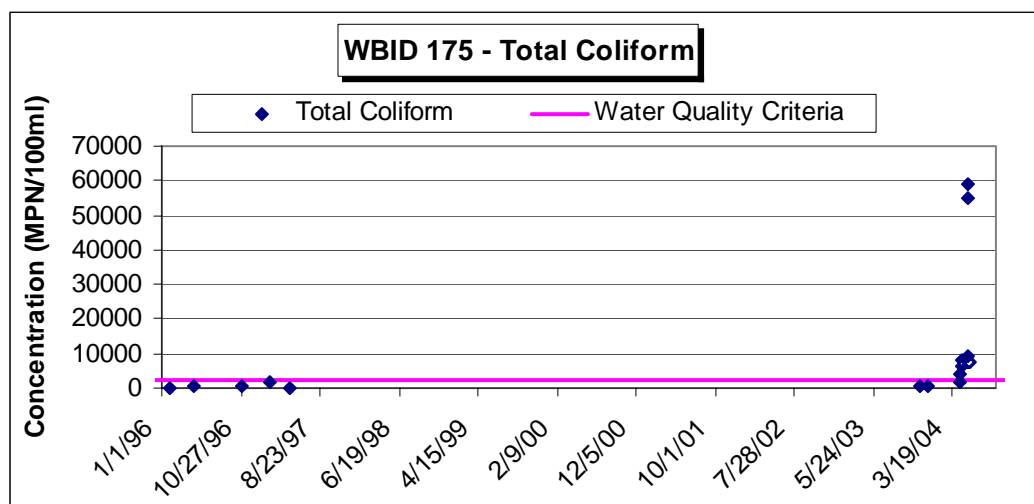


Figure A- 3. Total coliform measurements in Muddy Branch (WBID 175)

Table A- 4. Total coliform data collected in Thompson Pond (WBID 272)

Date	Station	Result	Rcode
12/15/03	THOMPSON POND DITCH AT MCKINNIE RD SOUTH OF GILLEY RD	660	Q
12/15/03	THOMPSON POND DITCH AT SALEM CHURCH RD.	740	Q
4/19/04	Thompson Pond (end of dock - TP10)	1480	
4/20/04	Thompson Pond (end of dock - TP10)	3800	
4/21/04	Thompson Pond (end of dock - TP10)	2000	
4/22/04	Thompson Pond (end of dock - TP10)	1500	
4/23/04	Thompson Pond (end of dock - TP10)	3950	
5/17/04	Thompson Pond (end of dock - TP10)	4600	
5/18/04	Thompson Pond (end of dock - TP10)	5267	
5/19/04	Thompson Pond (end of dock - TP10)	6800	
5/20/04	Thompson Pond (end of dock - TP10)	8067	
5/21/04	Thompson Pond (end of dock - TP10)	6800	

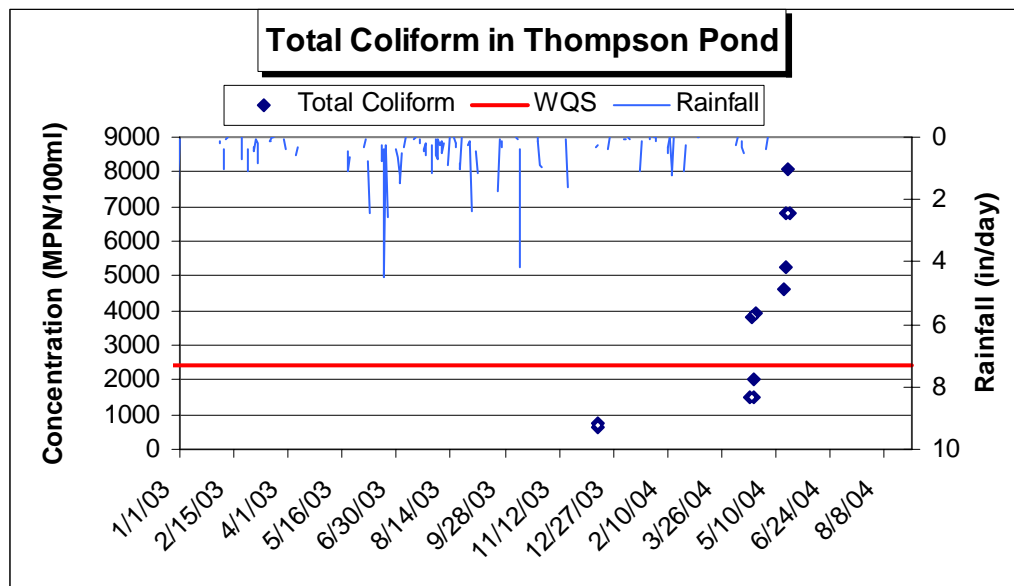


Figure A- 4. Total coliform measurements in Thompson Pond (WBID 272)

Note: rainfall measured at Marianna Airport

Table A- 5. Total coliform measurements in Huckleberry Creek (WBID 1286)

Date	Station	Time	Result	Rcode
3/3/98	21FLPNS HC21D	0	70	
2/10/97	21FLPNS HC21D	0	240	
5/27/97	21FLPNS HC21D	0	1200	
12/16/97	21FLPNS HC21D	0	100	
1/6/98	21FLPNS HC21D	0	700	
1/20/98	21FLPNS HC21D	0	200	
2/17/98	21FLPNS HC21D	0	250	
2/3/98	21FLPNS HC21D	0	660	
6/17/03	21FLWQA 294405308504411	0	28000	
4/20/04	HC05 (at confluence with Jackson River)	1020	3200	
4/21/04	HC05 (at confluence with Jackson River)	930	4900	
4/22/04	HC05 (at confluence with Jackson River)	820	3300	
4/23/04	HC05 (at confluence with Jackson River)	840	2500	
5/17/04	HC05 (at confluence with Jackson River)	1524	5266	
5/18/04	HC05 (at confluence with Jackson River)	840	7400	
5/19/04	HC05 (at confluence with Jackson River)	915	15917	
5/20/04	HC05 (at confluence with Jackson River)	852	10200	
5/21/04	HC05 (at confluence with Jackson River)	735	5400	
5/22/04	HC05 (at confluence with Jackson River)	820	6200	
11/17/03	HUCKLEBERRY CREEK (HC50)	1219	380	Q
11/17/03	HUCKLEBERRY CREEK ~150YDS IN FROM MOUTH (HC70)	1305	320	Q
12/15/03	HUCKLEBERRY CREEK (HC40)	1256	230	Q
12/15/03	HUCKLEBERRY CREEK (HC50)	1326	230	Q
12/15/03	HUCKLEBERRY CREEK ~150YDS IN FROM MOUTH (HC70)	1346	310	Q
6/17/03	21FLWQA 294423208504412	0	1000	
6/17/03	21FLWQA 294448308504319	0	1700	
4/20/04	HC04 (at Moses Road)	803	8000	
4/21/04	HC04 (at Moses Road)	1140	8000	>
4/22/04	HC04 (at Moses Road)	1055	9600	
4/23/04	HC04 (at Moses Road)	730	6500	
5/17/04	HC04 (at Moses Road)	505	75000	
5/18/04	HC04 (at Moses Road)	730	55000	
5/19/04	HC04 (at Moses Road)	1030	76000	
5/20/04	HC04 (at Moses Road)	745	80000	>
5/21/04	HC04 (at Moses Road)	840	80000	
5/22/04	HC04 (at Moses Road)	740	80000	
11/17/03	HUCKLEBERRY CREEK AT RR NR TEAT'S RD (HC10)	1300	3800	Q
11/17/03	HUCKLEBERRY CREEK AT TEAT'S DOCK (HC25)	1205	400	Q
11/17/03	HUCKLEBERRY CREEK AT MOSES RD (HC7)	1430	4700	Q
12/15/03	TRIB TO HUCKLEBERRY CREEK AT TEAT'S RD UPS RR 10FT (HC9.9)	1123	70	BQ
12/15/03	HUCKLEBERRY CREEK AT RR NR TEAT'S RD (HC10)	1216	80	BQ
12/15/03	HUCKLEBERRY CREEK AT TEAT'S DOCK (HC25)	1231	530	Q
12/15/03	HUCKLEBERRY CREEK AT MOSES RD (HC7)	1030	620	Q

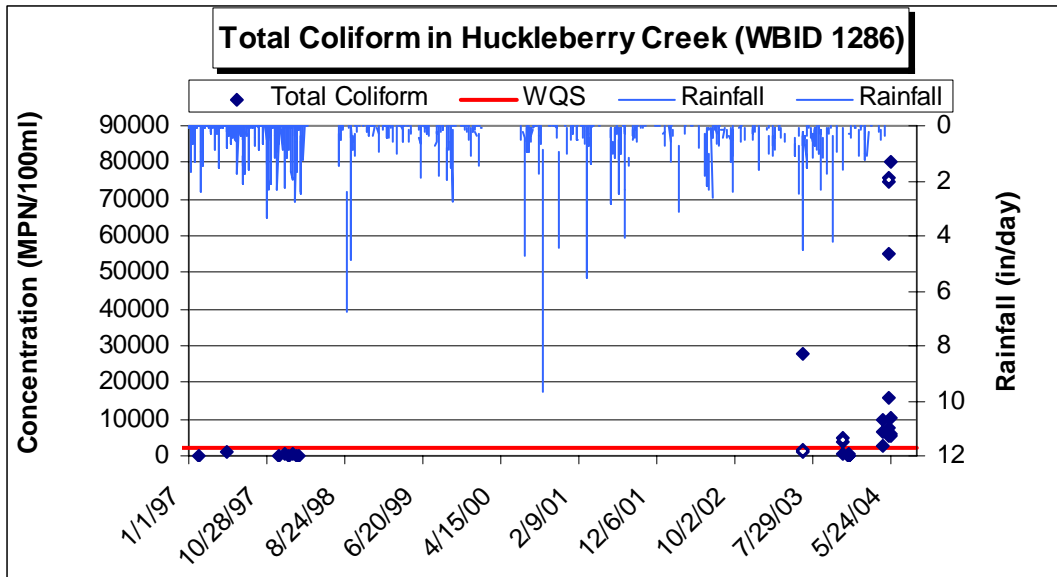


Figure A- 5. Total coliform measurements in Huckleberry Creek

Note: rainfall measured at Apalachicola Municipal Airport

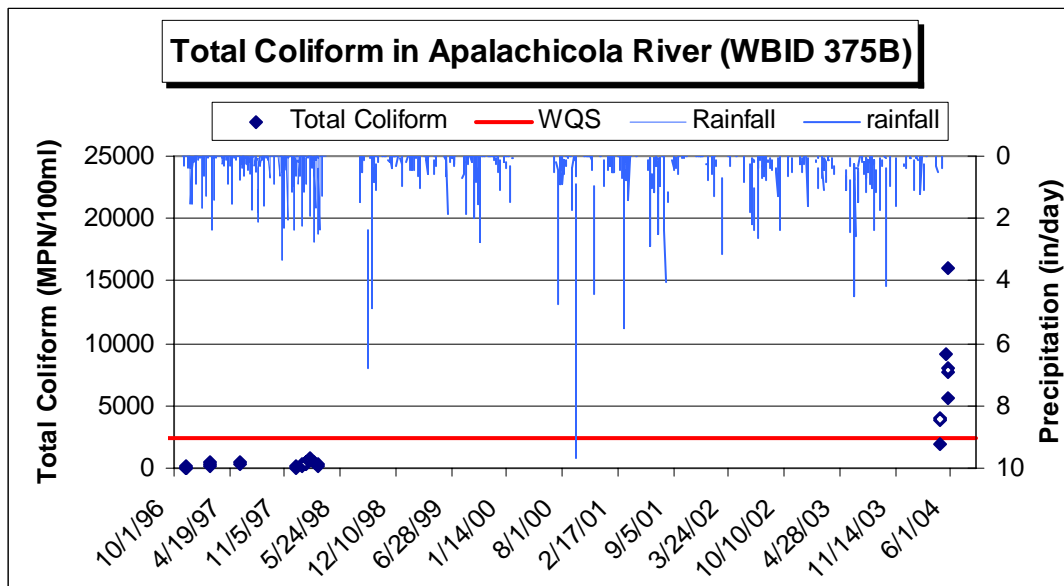


Figure A- 6. Total coliform measurements in Apalachicola River (WBID 375B)

Table A- 6. Total coliform data collected in Apalachicola River (WBID 375B)

Date	Station	Result	Rcode
5/27/97	21FLPNS AR20	510	
2/17/98	21FLPNS AR20	370	
2/3/98	21FLPNS AR20	750	
1/20/98	21FLPNS AR20	400	
3/3/98	21FLPNS AR20	270	
12/16/97	21FLPNS AR20	200	
1/6/98	21FLPNS AR20	300	
2/10/97	21FLPNS AR20	360	
11/12/96	21FLPNS AR20	130	
1/6/98	21FLPNS AR22	250	
5/27/97	21FLPNS AR22	320	
2/3/98	21FLPNS AR22	690	
3/3/98	21FLPNS AR22	300	
12/16/97	21FLPNS AR22	150	
2/17/98	21FLPNS AR22	520	
2/10/97	21FLPNS AR22	450	
1/20/98	21FLPNS AR22	460	
11/12/96	21FLPNS AR22	20	
11/12/96	21FLPNS LSM33	40	
3/3/98	21FLPNS LSM33	230	
12/16/97	21FLPNS LSM33	70	
5/27/97	21FLPNS LSM33	400	
2/10/97	21FLPNS LSM33	270	
1/20/98	21FLPNS LSM33	310	
2/17/98	21FLPNS LSM33	330	
11/12/96	21FLPNS SMR35	50	
2/10/97	21FLPNS SMR35	215	
5/27/97	21FLPNS SMR35	530	
12/16/97	21FLPNS SMR35	130	
1/6/98	21FLPNS SMR35	230	
1/20/98	21FLPNS SMR35	330	
2/3/98	21FLPNS SMR35	580	
2/17/98	21FLPNS SMR35	440	
3/3/98	21FLPNS SMR35	230	
4/20/04	AR02	3800	
4/21/04	AR02	1900	
4/22/04	AR02	4000	
4/23/04	AR02	1900	
5/17/04	AR02	9200	
5/18/04	AR02	9133	
5/19/04	AR02	8,000	
5/20/04	AR02	16,000	
5/21/04	AR02	7733	
5/22/04	AR02	5533	

Table A- 7. Fecal Coliform data collected in WBID 375A

Date	Station	result	rcode
11/12/96	21FLPNS AR26	24	
2/10/97	21FLPNS AR26	230	
5/27/97	21FLPNS AR26	36	
12/16/97	21FLPNS AR26	72	
1/6/98	21FLPNS AR26	270	
1/20/98	21FLPNS AR26	104	
2/3/98	21FLPNS AR26	320	
2/17/98	21FLPNS AR26	280	
3/3/98	21FLPNS AR26	174	
11/12/96	21FLPNS AR27	10	
2/10/97	21FLPNS AR27	174	
5/27/97	21FLPNS AR27	14	
12/16/97	21FLPNS AR27	74	
1/6/98	21FLPNS AR27	84	
1/20/98	21FLPNS AR27	200	
2/3/98	21FLPNS AR27	300	
2/17/98	21FLPNS AR27	280	
3/3/98	21FLPNS AR27	190	
11/12/96	21FLPNS GC23	56	
2/10/97	21FLPNS GC23	200	
5/27/97	21FLPNS GC23	22	
12/16/97	21FLPNS GC23	18	
1/6/98	21FLPNS GC23	150	
1/20/98	21FLPNS GC23	210	
2/3/98	21FLPNS GC23	230	
2/17/98	21FLPNS GC23	250	
3/3/98	21FLPNS GC23	114	
11/12/96	21FLPNS LSM31	14	
2/10/97	21FLPNS LSM31	120	
5/27/97	21FLPNS LSM31	12	
12/16/97	21FLPNS LSM31	38	
1/20/98	21FLPNS LSM31	120	
2/3/98	21FLPNS LSM31	235	
2/17/98	21FLPNS LSM31	200	
3/3/98	21FLPNS LSM31	200	
12/15/03	7545	48	Q
12/15/03	7550	60	Q
11/17/03	7550	16	BQ
12/15/03	7555	44	Q
11/17/03	7560	12	BQ
12/15/03	7560	32	BQ
6/19/03	9000	200	Q
4/20/04	SC08 (at mouth of Scipio Cr)	20	estimated
4/21/04	SC08 (at mouth of Scipio Cr)	25	
4/22/04	SC08 (at mouth of Scipio Cr)	9	estimated
4/23/04	SC08 (at mouth of Scipio Cr)	8	estimated
5/17/04	SC08 (at mouth of Scipio Cr)	6	estimated
5/18/04	SC08 (at mouth of Scipio Cr)	20	
5/19/04	SC08 (at mouth of Scipio Cr)	17	estimated
5/20/04	SC08 (at mouth of Scipio Cr)	50	
5/21/04	SC08 (at mouth of Scipio Cr)	8	estimated
5/22/04	SC08 (at mouth of Scipio Cr)	26	
12/15/03	7551	240	Q
12/15/03	7554	93	Q
11/17/03	7554	88	AQ
11/17/03	7556	54	Q
12/15/03	7556	77	AQ

Date	Station	Result	Rcode
12/16/97	21FLPNS AR26	200	
11/12/96	21FLPNS AR26	30	
5/27/97	21FLPNS AR26	210	
1/20/98	21FLPNS AR26	280	
2/3/98	21FLPNS AR26	530	
1/6/98	21FLPNS AR26	600	
3/3/98	21FLPNS AR26	250	
2/17/98	21FLPNS AR26	550	
2/10/97	21FLPNS AR26	600	
5/27/97	21FLPNS AR27	280	
2/10/97	21FLPNS AR27	350	
1/20/98	21FLPNS AR27	480	
11/12/96	21FLPNS AR27	60	
3/3/98	21FLPNS AR27	400	
12/16/97	21FLPNS AR27	170	
1/6/98	21FLPNS AR27	350	
2/17/98	21FLPNS AR27	600	
2/3/98	21FLPNS AR27	710	
2/17/98	21FLPNS GC23	470	
3/3/98	21FLPNS GC23	295	
2/10/97	21FLPNS GC23	500	
1/20/98	21FLPNS GC23	580	
12/16/97	21FLPNS GC23	60	
5/27/97	21FLPNS GC23	700	
11/12/96	21FLPNS GC23	300	
2/3/98	21FLPNS GC23	840	
1/6/98	21FLPNS GC23	500	
3/3/98	21FLPNS LSM31	350	
2/17/98	21FLPNS LSM31	550	
5/27/97	21FLPNS LSM31	160	
2/3/98	21FLPNS LSM31	495	
12/16/97	21FLPNS LSM31	120	
1/20/98	21FLPNS LSM31	360	
2/10/97	21FLPNS LSM31	210	
11/12/96	21FLPNS LSM31	300	
12/15/03	7545	220	Q
12/15/03	7550	230	Q
11/17/03	7550	150	BQ
11/17/03	7560	100	BQ
12/15/03	7560	230	Q
6/19/03	9000	800	Q
4/20/04	SC08	3800	
4/21/04	SC08	1600	QC
4/22/04	SC08	7000	
4/23/04	SC08	2400	
5/17/04	SC08	7000	
5/18/04	SC08	16,833	
5/19/04	SC08	11,833	
5/20/04	SC08	17,333	
5/21/04	SC08	5900	
5/22/04	SC08	5700	
12/15/03	7551	240	Q
12/15/03	7554	420	Q
11/17/03	7554	370	AQ
12/15/03	7554	630	Q
12/15/03	7555	180	BQ
11/17/03	7556	200	Q
12/15/03	7556	330	AQ

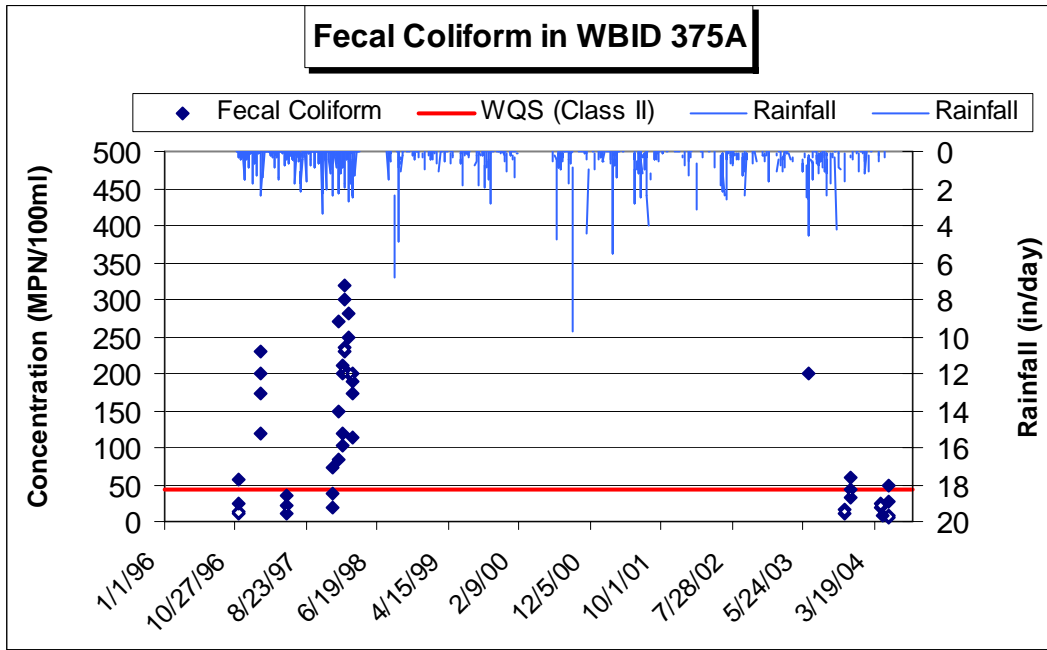


Figure A- 7. Fecal coliform measurements in WBID Apalachicola River – Scipio Creek (WBID 375A)

Note: rainfall measured at Apalachicola Airport

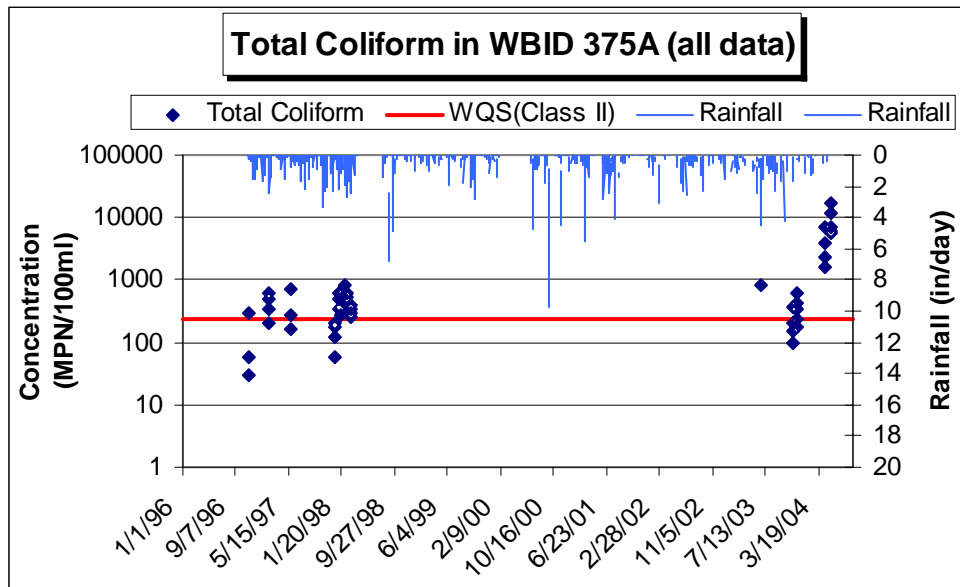


Figure A- 8. Total coliform measurements in WBID 375A

Note: Data plotted on log scale to show variability; rainfall measured at Apalachicola Airport.

APPENDIX B CALCULATION OF COLIFORM TMDLS

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Constructing Flow Duration Curves

One of the shortcomings of using flow and load duration curves for data analysis is the method requires a significant amount of flow data. If continuous flow gages are not located in a WBID or if the locations of the water quality monitoring station and flow gage are not the same, techniques must be used to estimate flows. If a flow gage is operational in a WBID, flow at the time of sampling was assumed to approximate flow measured at the gage on the same day.

The common approach for estimating flow at a monitoring station that is at a different location than the gage, is to multiply the flow at the gaged site by the drainage area ratio between the two sites.

This approach is valid when the drainage area ratio of the ungaged site to the gaged site is within about 0.5 to 1.5. A continuous flow gage is not located in Huckleberry Creek. FDEP estimated flows at the monitoring stations in Huckleberry Creek using a weighted drainage area approach and measured flows at the gage on Telogia Creek (USGS 02330100).

A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The confidence in the duration curve approach in predicting realistic percent load reductions increases when longer periods of record are used to generate the curves. The flow duration curve is easily generated in a spreadsheet, such as Excel, by using the percentile function and the flow record to generate the flow at a given duration interval. For example, at the 90th duration interval, the percentile function calculates the flow that is equal or exceeded 90 percent of the time. Flows toward the right side of the plot are flows exceeded in greater frequency and are indicative of low flow conditions. Flows on the left side of the plot represent high flows and occur less frequently.

The flow duration curve for Muddy Branch (WBID 175) is based on the continuous flow record collected at USGS 02358784 (Muddy Branch near Marianna, FL). This gage was in operation from October 1998 through September 2003. Attempts were made to extend the record to the time of water quality sampling but it was not possible to find a comparable gage with the necessary flow record in the HUC. Using the available flow record, the flow duration curve for Muddy Branch is shown in Figure B- 1. A review of the flow data, indicates Muddy Branch is dry during long periods in several seasons. As a result, the flow duration curve approaches zero at the 75th duration interval. The flow duration curve is plotted on a log scale to show variability in scale.

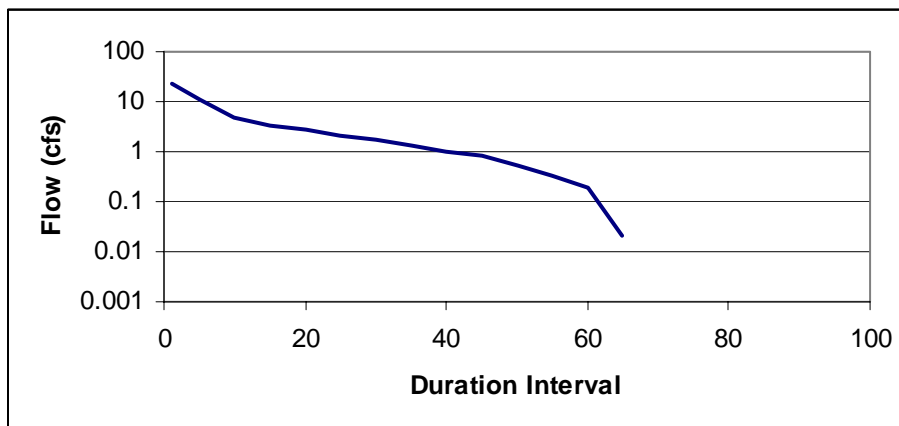


Figure B- 1. Flow duration curve for Muddy Branch (WBID 175)

Constructing Load Duration Curves

The load duration curve is a visual display of the existing and allowable loads at each interval on the flow duration curve. The existing loads are based on the instream coliform concentrations measured during ambient monitoring and an estimate of flow at the station. Allowable loads, or TMDL, are based on the flow values at each interval on the flow duration curve and the applicable water quality criterion. Because insufficient data were collected to evaluate either the geometric mean or not to exceed percentage criteria, the one-day maximum criterion for coliforms is the target criterion in these TMDLS.

The water quality samples collected at a monitoring station are separated into two groups depending on whether they violate the numerical target. Using Equation 1 (see Section 5.3.1), loads are calculated for each sample using the flow estimated or measured on the sampling day. Loads are expressed in units of counts per day to reflect the instantaneous criterion. The two groups of loads are plotted on the load duration curve with unique symbols. The positioning of the loads on the curve is based on the duration interval of the stream flow. Loads positioned above the allowable load line represent violations of the criterion while loads positioned below the line represent compliance with the criterion.

TMDL and existing loads are separated into zones of impairment. The zone representing the largest number of violations is selected for the TMDL. If five or more samples violate the criteria, the reduction required to achieve standards is also calculated using a trendline drawn through the data violations. The trendline equation is used to estimate violations over the range of intervals on the duration curve. The type of trend line used (i.e., linear, logarithmic, polynomial, etc.), reflected the best visual fit of the data and had the highest correlation coefficient (R^2 value). Neither of the load duration curves developed in the Apalachicola-Chipola Basin had sufficient data violations to construct a trendline.

The TMDL value is separated into WLA and LA components. If NPDES facilities are located in the watershed and discharge coliforms, the WLA component is assumed constant and is based on the facility design flow and one-day maximum concentration limit. The LA component is obtained by subtracting the WLA from the TMDL. The MOS is implicit and not assigned a value in the TMDL equation.

Huckleberry Creek (WBID 1286)

The TMDL for Huckleberry Creek is based on water quality samples at the downstream location (HC05) as this results in the largest percent reduction when compared to the reduction calculated at the upstream station. A load duration curve was used to develop the TMDL value as shown in Figure B- 2. Sufficient data are available to calculate the percent reduction necessary to meet both the acute (i.e., not to exceed 400 in 10% of samples or 800 on any one day) and chronic (i.e., geometric mean) criteria. The reductions necessary to meet both the acute and chronic criteria are shown in Table B- 1.

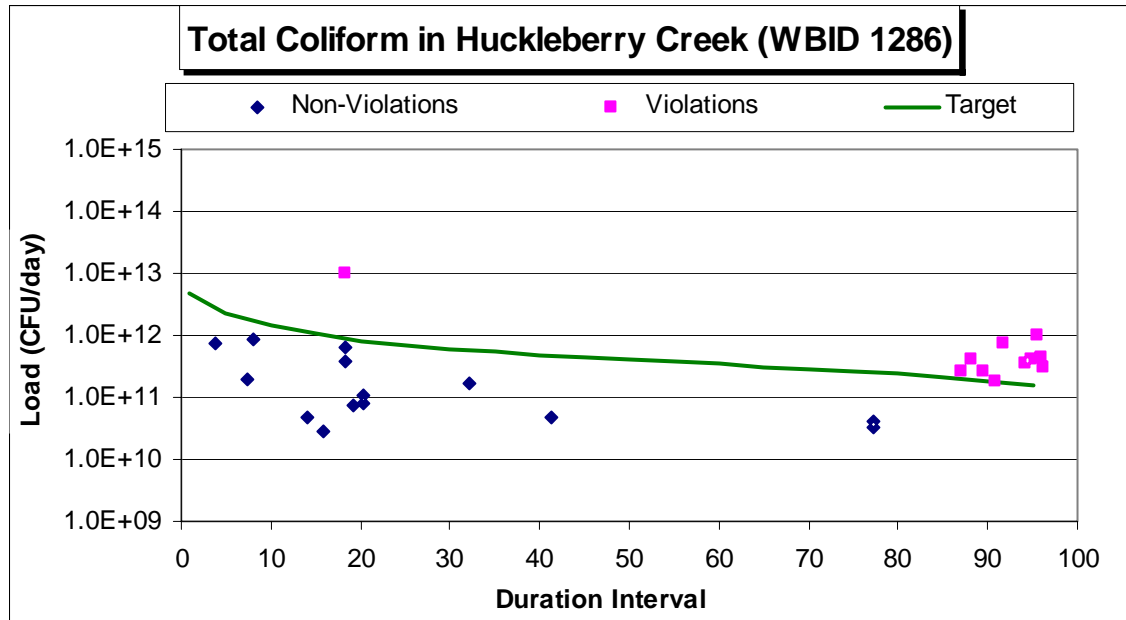


Figure B- 2. Load duration curve for total coliform in Huckleberry Creek (WBID 1286)

Table B- 1. TMDL and percent reduction for total coliform in Huckleberry Creek (WBID 1286)

Zone Approach for total coliform in Huckleberry Creek (WBID 1286):

a) Existing Loads expressed as cfu/day (average violation in each zone); TMDL is midpoint in range

	High 10)	(0- Moist (10-40)	Mid-Range (40-60)	Dry 90)	(60- Low (90-100)
TMDL	2.34E+12	8.19E+11	4.09E+11	2.62E+11	1.51E+11
Existing		1.03E+13		3.07E+11	4.89E+11
% Redux (acute)		92.1		14.6	69.2

% Redux (chronic): 82.0%

Note: Chronic reduction based on existing geometric mean concentration of 5543 MPN/100ml measured at HC05 and water quality criteria of 1000 MPN/100ml; acute criteria based on reduction necessary to achieve 400 MPN/100ml

WLA Component:

Huckleberry STP - no permit limits for total coliform; therefore, WLA = N/A (i.e., not applicable)

TMDL set at low flow zone

LA Component = TMDL = 1.51E+11 cfu/day (average value within dry zone)

MOS = implicit (base loads and reductions on violations in the zone having the greatest reduction; basing the TMDL on the more stringent of the Water Quality Criteria)

Percent Reduction = 82.0%

Thompson Pond

The total coliform TMDL for Thompson Pond (WBID 272) is based on the percent reduction necessary to meet the geometric mean criteria. Violations of the chronic criteria result in a larger reduction than the acute criteria. Flow was not available at the time of sampling and it was not possible to express the TMDL as a load. TMDL components for Thompson Pond are shown in Table B- 2. The reduction required to meet the acute criteria is 70% based on a maximum instream concentration of 8067 MPN/100ml. The reduction of 74% is based on the chronic criteria of 1000 MPN/100ml and a calculated geometric mean concentration of 3784 MPN/100ml.

Table B- 2. TMDL components for total coliform in Thompson Pond (WBID 272)

WLA	LA	MOS	TMDL
Not applicable	74% reduction	implicit	74% reduction

Muddy Branch (WBID 157)

The USGS operated a continuous flow gage on Muddy Branch (USGS 02358784) near Marianna, FL from October 1998 through September 2003. Water quality samples were not collected during the time the gage was operational (see Table A- 2). Attempts were made to correlate flows at a nearby gage to the Muddy Branch gage as a way to estimate flow at the time of sampling but the attempts were unsuccessful. A flow duration curve was derived based on the flow record collected at the Marianna gage (see Figure B- 1). The load duration curve for Muddy Branch is shown in Figure B- 3 (loads plotted on log scale to illustrate variability in data).

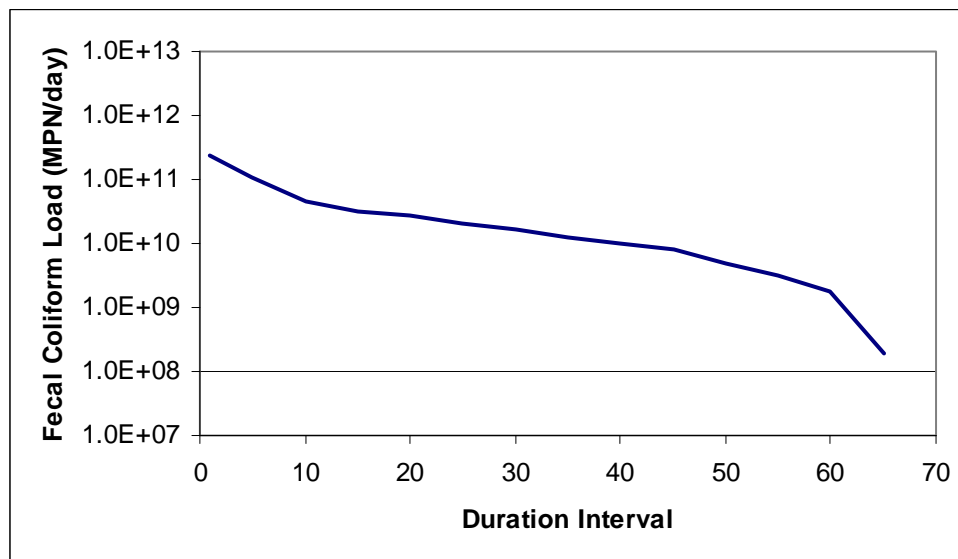


Figure B- 3. Fecal coliform load duration curve for Muddy Branch (WBID 175)

Rainfall measurements collected at the Shipley 3E NOAA station were plotted with water quality samples collected in 1997 and 2003 (see Figure A- 2). The limited precipitation and water quality data is inconclusive as to whether elevated coliform concentrations occur in response to rainfall events.

The fecal coliform TMDL is expressed as the load occurring at the 50th duration interval. Sufficient data are available to evaluate all three tiers of the water quality standard. The maximum one-day concentration is 1600 mpn/100ml. The maximum concentration not to exceed 400 mpn/100ml in 10 percent of the samples collected in 30 days is 390 mpn/100ml. The geometric mean concentration is 95 mpn/100ml. Of the samples collected in 30 days, only the one-day maximum criteria is violated. Muddy Branch currently does not have any NPDES facilities discharging fecal coliform bacteria; therefore, the TMDL value is assigned to nonpoint sources. TMDL components for fecal coliform are shown in Table B- 3.

Table B- 3. TMDL components for fecal coliform in Muddy Branch (WBID 175)

Max. One-Day Concentration (violations only)	1600 MPN/100mL
TMDL	5.04×10^9 cfu/day
WLA	Not applicable
LA	5.04×10^9 cfu/day
MOS	Implicit
Percent Reduction (see note 1)	50%

Note:

1. Percent reduction necessary to obtain an instream concentration of 800 MPN/100ml (i.e., $(1600-800)/1600 \times 100$).

The approach for the total coliform TMDL in Muddy Branch is similar to the fecal coliform approach except all water quality criteria are violated. The total coliform TMDL is expressed as the load occurring at the 50th duration interval. Reductions to criteria are calculated and the largest value is selected for the TMDL. The maximum one-day concentration violating standards is 59,000 mpn/100ml and reducing this concentration to 2400 mpn/100ml results in a 96% reduction. The geometric mean concentration calculated at station MC07 is 8983 mpn/100ml and the concentration not to exceed 20% of a concentration of 1000 mpn/100ml is 9000. The reduction of both these concentrations to criteria (i.e., 1000 mpn/100ml) is 89 percent. The total coliform load duration curve is shown in Figure B- 4. TMDL components for total coliform are shown in Table B- 4.

Table B- 4. TMDL components for total coliform in Muddy Branch

Maximum One Day Concentration	59,000 MPN/100mL
TMDL	3.02×10^{10} cfu/day
WLA	Not applicable
LA	3.02×10^{10} cfu/day
MOS	Implicit
Percent Reduction (see note 1)	96%

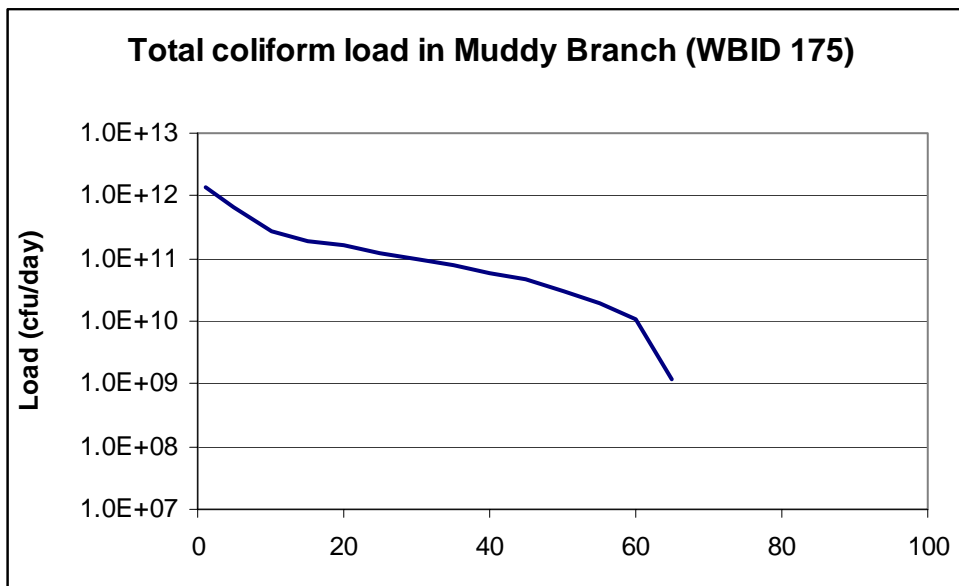


Figure B- 4. Total coliform load in Muddy Branch (WBID 175)

(Note: loads plotted on log scale to show variability)

APPENDIX C EFDC MODELING REPORT OF APALACHICOLA BAY

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Introduction

The Apalachicola River is formed by the confluence of the Chattahoochee and Flint Rivers at Lake Seminole, from which it flows across the Georgia-Florida line and through the Florida Panhandle. The river flows 109 miles through relatively undeveloped coastal plains into Apalachicola Bay. The City of Apalachicola is located at the mouth of the river. The entire watershed covers a drainage area of approximately 19,500 mi² and gives rise to a relatively large discharge to the bay. This report addresses the Apalachicola Bay segments (WBID 1274 and 1274B) and two lower Apalachicola River segments (WBIDs 375A and 375B).

While the Bay is classified as a Class 2 Marine segment, designated for shellfish harvesting and propagation, the lower river segments are both classified as Class 3 Freshwater segments. All three WBIDs are listed as impaired for fecal coliform on Florida's 303(d) list. The Class 2 designation of the bay has generated a large number of data points within the bay. Further, a Comprehensive Shellfish Harvesting Survey (FDEP) conducted in 1997 provides insight into the tidal exchange and dilution of pathogen pollution within the bay.

The following report presents the results of the Total Maximum Daily Load (TMDL) analysis for fecal coliform for these WBIDs. The fecal coliform TMDL has a target of 38.7 MPN/100mL not to exceeded more than 10 percent of the time, and includes a 10 percent explicit Margin Of Safety (MOS). The total coliform TMDL has a target of 207 MPN/100mL not to exceeded more than 10 percent of the time, and includes a 10 percent explicit MOS. Since the bay WBIDs (1274 and 1274B), have more stringent criteria than WBIDs 375A and 375B, it was assumed that targeting the bay would accommodate the other listed water bodies. The target coliform concentrations in WBID 375A were Class II criteria.

Data Availability and Analysis

A wide range of data and information were used to characterize the conditions of the Apalachicola River and Bay system. The categories of data used include physiographic data that describe the physical conditions of the watershed, environmental monitoring data that identify potential pollutant sources and their contribution, and in-stream water quality monitoring data.

Instream Flow Data

There is one continuous flow gage located on the Apalachicola River. Data collected at the gage were used to characterize hydrologic conditions necessary for the calibration of simulations. Table C- 1 lists the USGS streamflow station used in this study and the corresponding period of record. Figure C- 1 shows the location of the USGS streamflow station used in the analysis. Figure C- 2 shows the model grid. Figure C- 3 presents the daily average flow values for the period of record at the USGS gage. FDEP give more emphasis to water quality data collected after 1996. However, to gain insight on the hydrology affecting the bay historically, it is worthwhile to present the entire period of record. The year 1997 was selected for the simulation period based on the reasonableness of the daily average flow values covering both high and low flows. Flow data from the USGS station were area-weighted to estimate the hydrology within the study area, downstream of the gage.

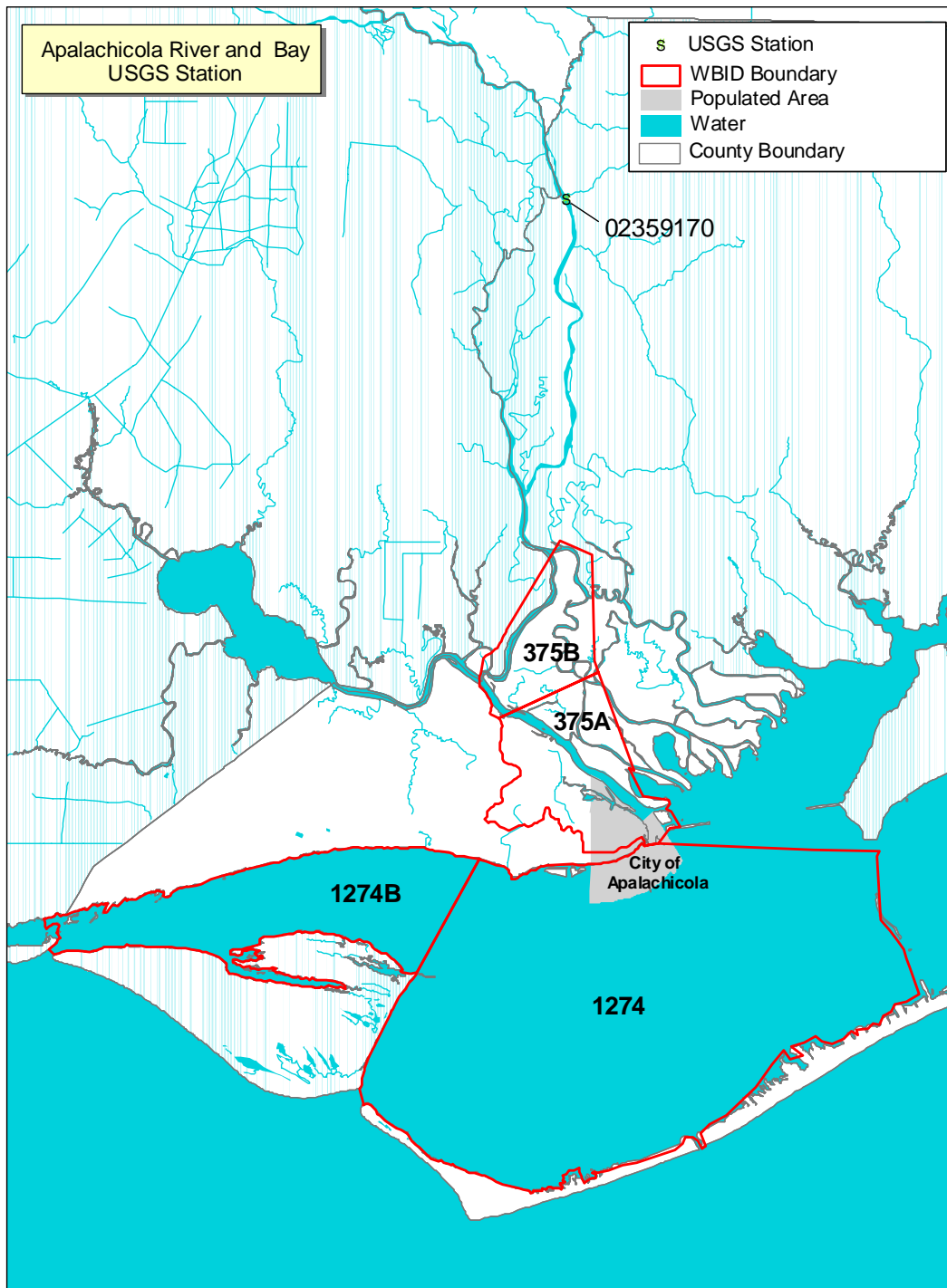


Figure C- 1. USGS Streamflow Gage 02359170, Apalachicola River Near Sumatra, FL

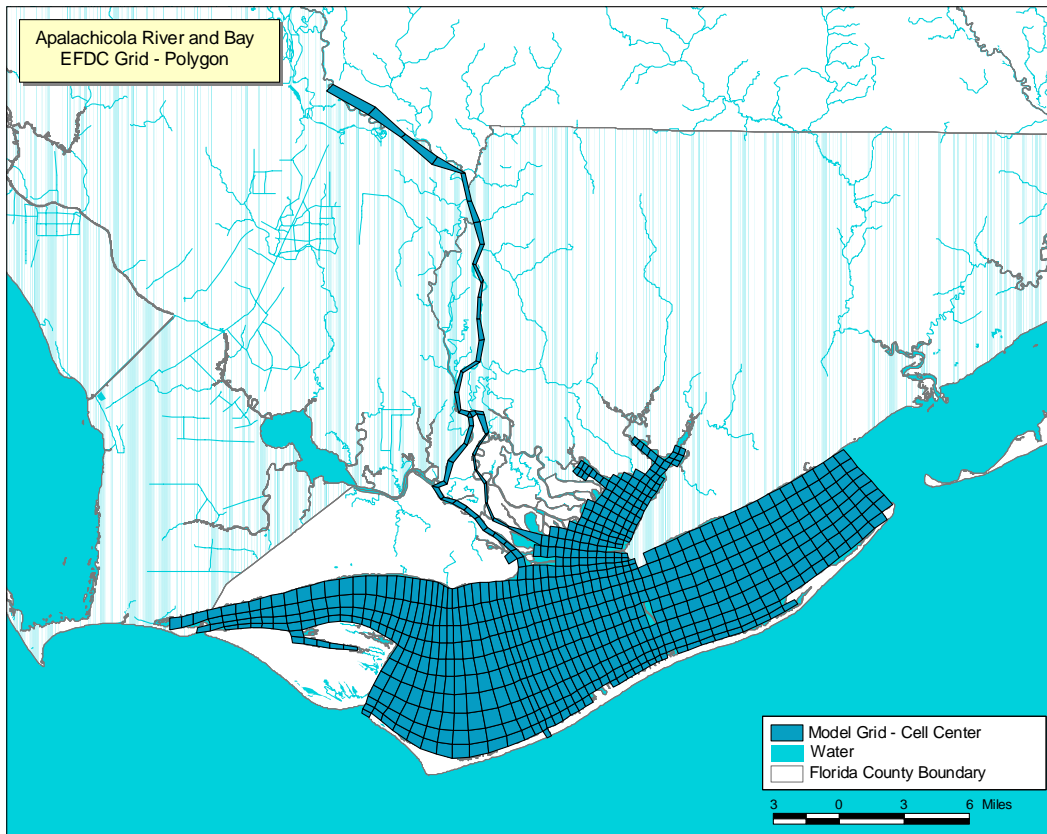


Figure C- 2. Apalachicola River and Bay Model Grid

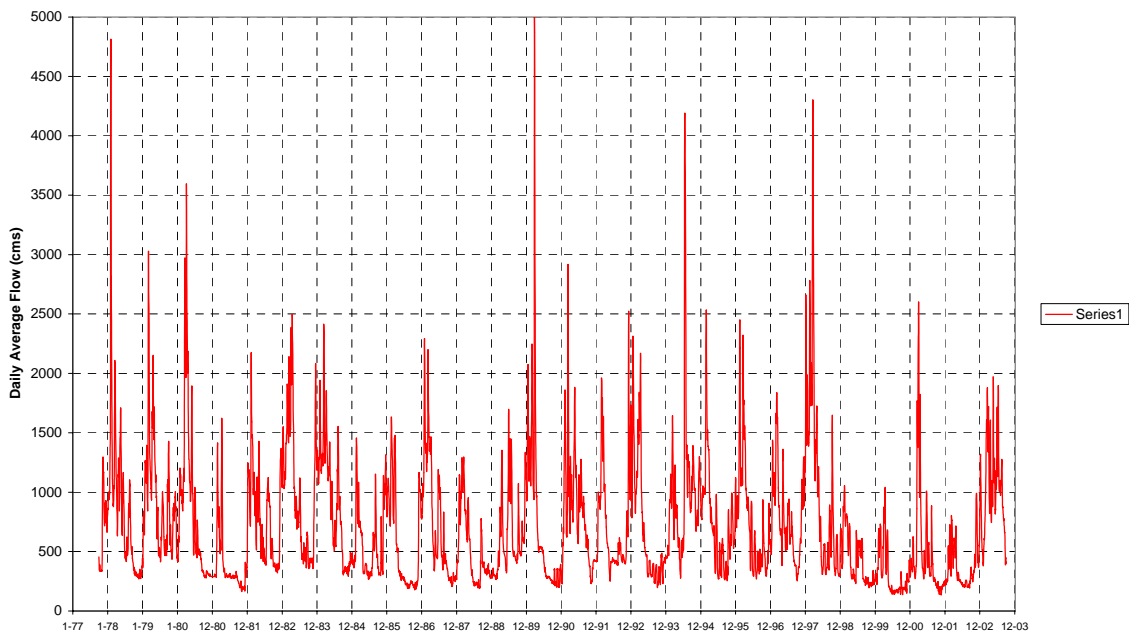


Figure C- 3. USGS Streamflow Period of Record at Gage 02359170

Table C- 1. USGS Station Employed in TMDL Development

Longitude (NAD27)	Latitude (NAD27)	USGS ID	Station Description	Period of Record
85.015556	29.949167	02359170	Apalachicola River near Sumatra, FL	10/01/1977- 09/30/2003

Meteorological Data

Meteorological data are a critical component of the instream model. The following meteorological parameters are necessary for the instream model:

- ☐ Rainfall,
- ☐ Solar radiation (computed),
- ☐ Cloud cover (estimated),
- ☐ Evaporation (computed),
- ☐ Relative humidity,
- ☐ Pressure,
- ☐ Air temperature, and
- ☐ Wind speed and direction.

Longterm hourly data of these parameters are available at a National Climatic Data Center (NCDC) weather station located at the Tallahassee Airport (WBAN 93805). Ideally, data closer to the study area is preferred, however, sufficient data were not available.

Tidal Data

Observed provisional tide data were retrieved from a NOAA NOS web site. The station was Apalachicola (8728690). The data were hourly values in meters referenced to Mean Lower Low Water (MLLW). The data were revised to reference North American Vertical Datum 1988 (NAVD) and constructed into the PSER.INP file.

Instream Water Quality

Water quality data applied in this TMDL were obtained directly from FDEP's in-house impaired waters database. This comprehensive database includes intensive monitoring data from several federal, state and local governments and is used primarily to assess waterbodies in Florida for inclusion on the 303(d) list of impaired water segments. The dataset is highly dynamic and is continually updated to adjust for additional data and accurate locational associations. Data is included only if assurances of the use of appropriate QA/QC measures are provided.

Within the three 303(d) listed WBIDs, there are approximately 4800 fecal coliform samples, taken between January, 1991 and June, 2003. Of these, approximately 4700 are sampled within WBID 1274, the Apalachicola Bay segment, and were taken mainly by FDEP's Shellfish Environmental Assessment Section (SEAS). Examination of the fecal coliform data from the stations confirms that water quality criteria were violated in the 303(d)-listed regions.

For the purposes of model configuration and calibration, 1997 was selected as the year for which the model would be run. Fecal coliform samples were taken year-round in 1997 and are representative of seasonal variances. In addition, coliform samples from other WBIDs within the general model area were incorporated into the analysis to allow for reasonable representation of additional inputs into the system. Figure C- 4 presents the locations of water quality stations with fecal coliform data taken in 1997, within the study area used in the model and/or for evaluation.

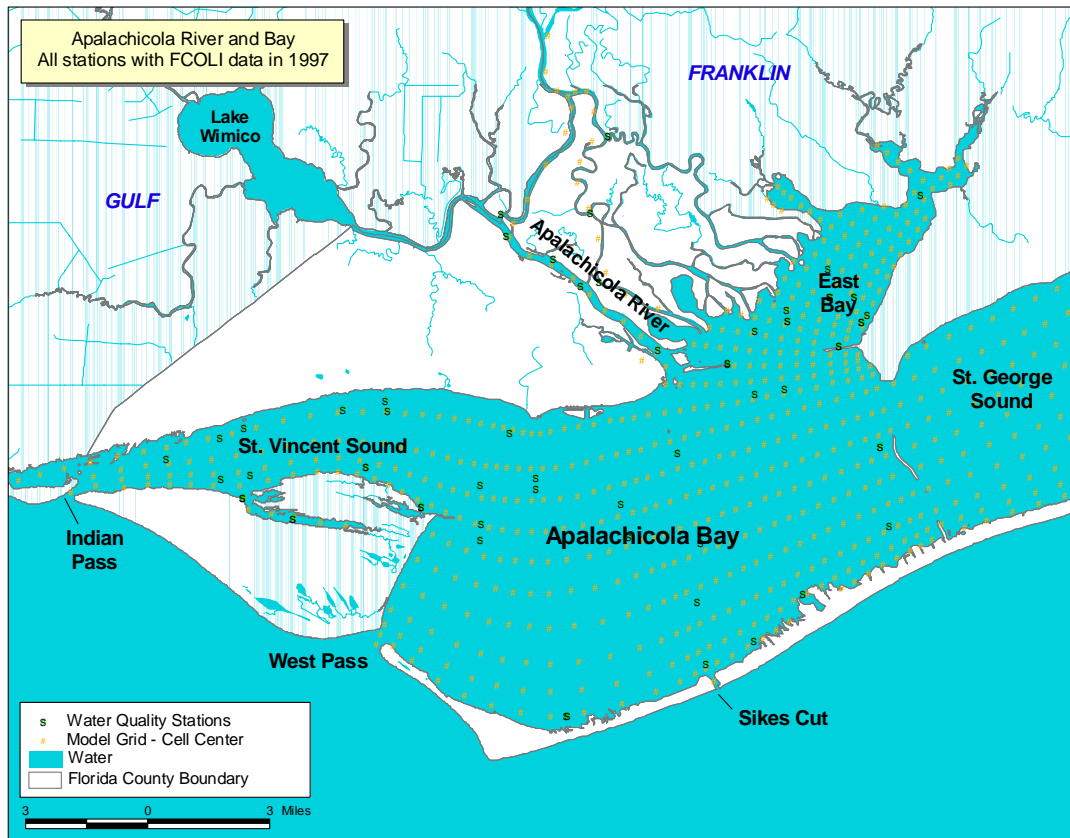


Figure C- 4. Stations with 1997 Fecal Coliform Measurements Used for Model Forcing

Point Source Discharge Data

There were two NPDES permitted point sources considered in the modeling effort. The City of Apalachicola WWTP (FL0038857) and a land application system for the City of East Point, the peninsula between East Bay and St George Bay. Table C- 2 presents the DMR discharge data used in the model for the City of Apalachicola WWTP. In terms of fecal coliform, the DMR data expressed only that the discharge concentration was at all times less than or equal to 2 MPN/100 mL. As a conservative assumption, the model was configured to 2 MPN/100mL for fecal coliform concentrations from this facility. There were no data available for the land application system, so the assumption was made that it did not discharge any fecal coliform. The City of Apalachicola WWTP discharge was assigned to the Apalachicola estuarine portion of the grid.

Table C- 2. City of Apalachicola WWTP (FL0038857) DMR Discharge Data for 1997

Date	Monthly Average Flow (cms)
1/31/1997	0.036
2/28/1997	0.042
3/31/1997	0.030
4/30/1997	0.027
5/31/1997	0.025
6/30/1997	0.022
7/31/1997	0.026
8/31/1997	0.042
9/30/1997	0.025
10/31/1997	0.024
11/30/1997	0.035
12/31/1997	0.038

Model Development

Establishing the relationship between instream water quality and source loading is an important component of TMDL development. It allows the estimation of the relative contribution of sources to total pollutant loading and the evaluation of potential changes to water quality resulting from implementation of various management options. This relationship can be developed using a variety of techniques ranging from qualitative assumptions based on scientific principles to numerical computer modeling. For these TMDLs a model was developed to allow the determination of the watershed loads to the listed reaches, the instream flow and transport within the listed reaches, and the instream distribution of fecal coliform. The model was:

- Environmental Fluid Dynamics Code (EFDC) – to simulate the flow, transport and decay of fecal coliform within the tidal zone of the listed reaches.

The EFDC model is capable of simulating the complex circulation in tidal waterbodies, including the density effects of salinity. A general description of the model along with brief description of the model calibration and application follow.

Receiving Water Model – Environmental Fluid Dynamics Code (EFDC)

The receiving water model takes the pollutant loads from the forcing definitions and accounts for the transport and transformation of material as it moves through the system. In the case of fecal coliform, the model simulates for the advective transport and dispersion of the input loads. Attenuation of fecal coliform loads is simulated by a first-order exponential decay.

Hydrodynamic Model Selection and Set Up (EFDC)

A hydrodynamic model was developed to simulate the flow, velocity and transport in the listed reaches. The EFDC model was applied with 737 horizontal grid cells, each with two vertical layers.

EFDC is a general purpose modeling package for simulating 1-D, 2-D, and 3-D flow and transport in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands and near shore to shelf scale coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications and is considered public domain software. The EFDC code has been extensively tested and documented.

Solutions for flow and transport can be made on multiple scales, i.e. 1-D or 2-D, within the EFDC modeling package. These models solve the 1-D/2-D continuity, momentum, and transport equations. The models use the efficient numerical solution routines within the more general 2-D/3-D EFDC hydrodynamic model, as well as transport, dispersion, and meteorological forcing functions. In addition, EFDC allows for specification of time variable water surface elevation at an open boundary, i.e. allowing a time-dependent Apalachicola Bay water surface elevation as a boundary condition. Specific details on the model equations, solution techniques and assumptions may be found in Hamrick (1996).

Inputs to the EFDC Apalachicola Bay hydrodynamic model include the following:

- ❑ Model grid and geometry,
- ❑ Apalachicola Bay tidal water surface elevation,
- ❑ Flows at headwaters and distributed flows from watershed, and
- ❑ Constituent concentrations at headwaters and distributed loads from watershed.

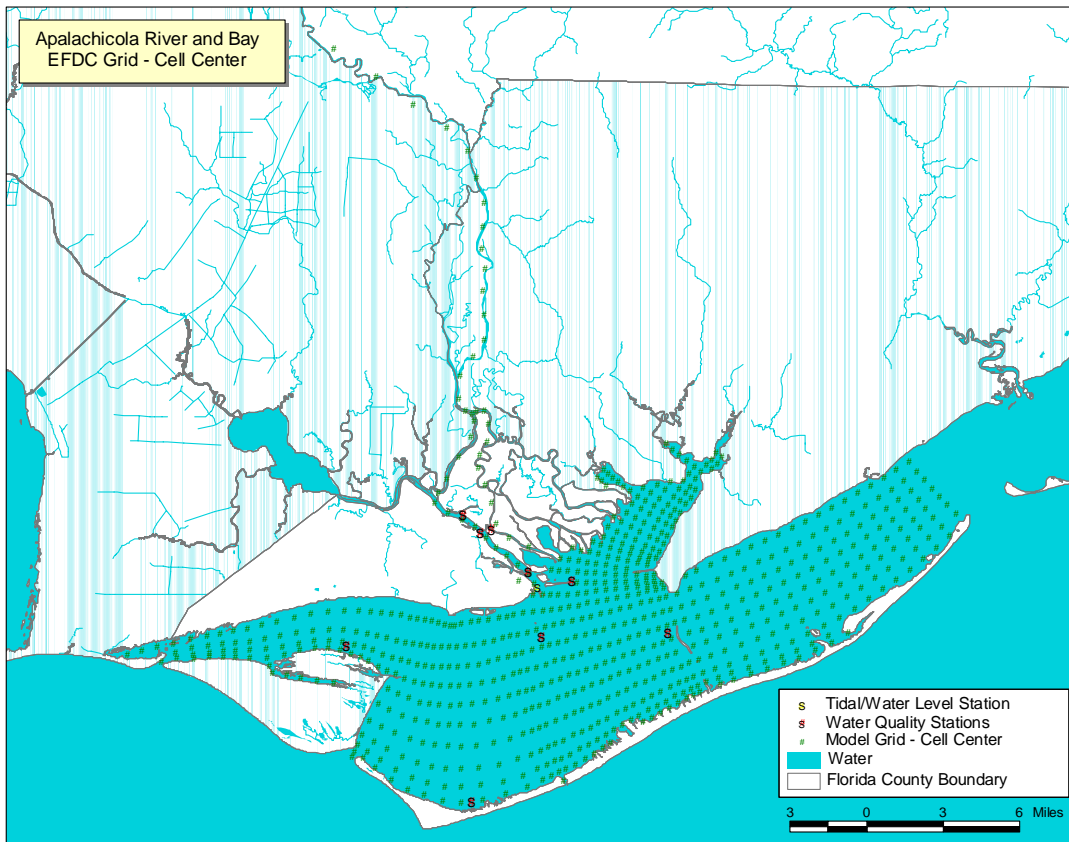


Figure C- 5. Extents of Instream Model Grid (Cell Centers)

The model grid was developed based upon the shorelines from USGS Topographic Maps, estimated cross-sectional information from GIS, bathymetry from NOAA, elevation data from the 30m resolution USGS National Elevation Dataset (NED), and stream connectivity from the National Hydrography Dataset (NHD) stream coverage. Figure C- 5 presents the extent of the EFDC model grid, a more complete image of which has been provided in Figure C- 2. The grid covers all of the listed reaches along with those stream sections required to provide overall connectivity between the listed segments and tributary inputs.

Flow inputs to the system consist of 12 horizontal cell locations. 1 headwater flow, 1 point source flow, and 10 tributary flows. Where available, observed fecal coliform concentrations were used to force fresh water input. However, adequate instream fecal coliform observations were not present for the main fresh water input, the Apalachicola River as represented by the USGS station number 02359170. A fecal coliform concentration for this input was developed through an iterative process of experimental constant values. The result was to use a fecal coliform concentration of 100 MPN/100 mL as a constant to create the baseline, existing, model run. Fecal coliform was modeled in EFDC as a conservative tracer with a decay rate of 0.8 1/d (Chapra 1997). Figure C- 6 presents the location of water quality stations used to help define model forcings.

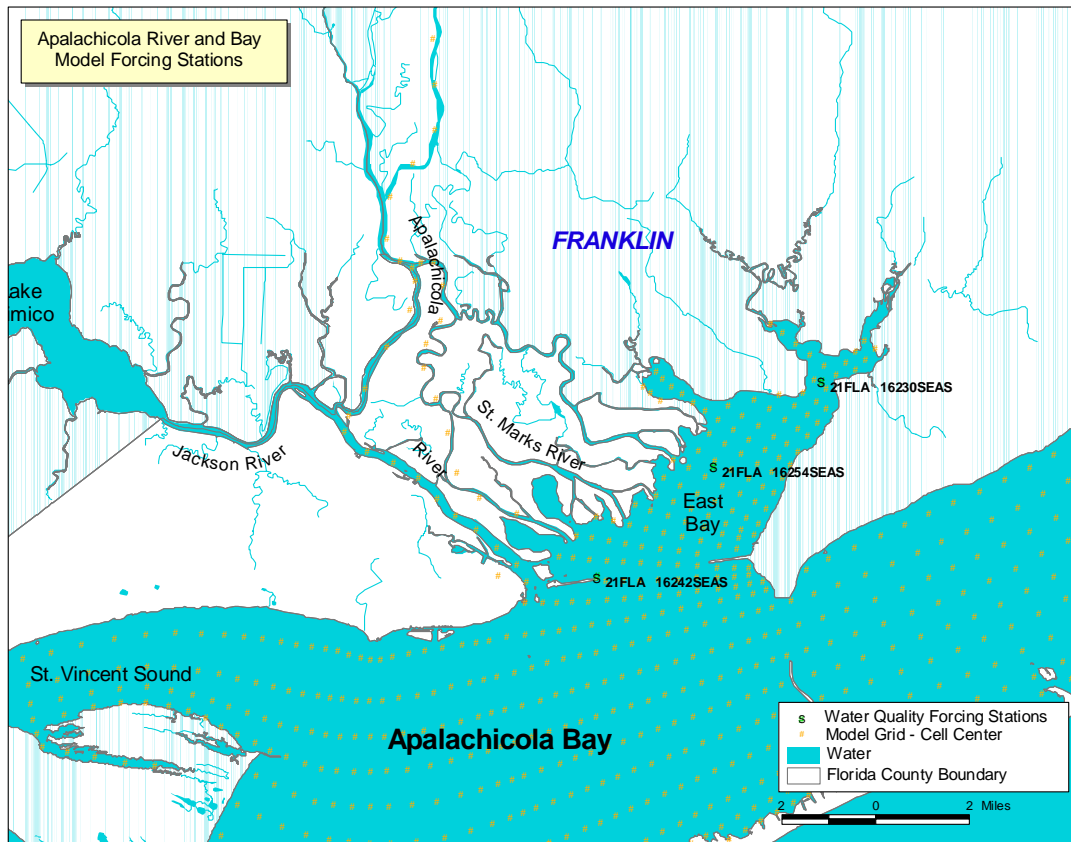


Figure C- 6. Study Area Stations with 1997 Fecal Coliform Measurements

The portion of the grid near East Pass, Sikes Cut, West Pass, and Indian Pass are controlled by the tidal surface boundary. Tidal EFDC simulations of Apalachicola Estuary and Bay result in time-series outputs of fecal coliform concentration at specified grid cells. This simulation includes the effects of the 10 MPN/100 mL open boundary condition.

Model Calibration

The calibration process was simplified to accommodate the limited resources and data. The calibration was focused in two areas; 1) flushing and 2) fecal coliform. According to the 1997 Shellfish Harvesting Survey conducted by FDEP, Apalachicola Bay is in an area of transition between the semi-diurnal tides of southwestern Florida and the diurnal tides of northwestern Florida. Based on the mean low tide average depth within the bay, and the mean tidal prism, there is a calculated exchange of 17 percent of bay water volume twice daily (FDEP, 1997). This information was used to obtain the hydrologic calibration of the model.

To confirm calibration, iterative model runs were plotted for simulated tides data from cell (38,13), the cell representing the location of NOAA NOS station 8728690, Apalachicola. From this chart, where available, the estimated minimum and maximum daily water level values were

manually selected and plotted separately (Figure C- 7). A simulated daily tidal range was then calculated using these pairings of minimum and maximum measurements, in meters, NAVD. Further, the assigned depths for all cells within the bay, provided in the <DXDY.INP> file, were used to calculate the average depth in the bay. A ratio of the average bay depth and the average simulated tidal range was then calculated, which corresponded to the percent exchange of bay water volume in one tidal cycle. The average tidal range allows a determination to be made as to how much water enters the bay, relative to its depth, over a period of time. The exchange calculation is summarized in Table C- 3.

Table C- 3. Apalachicola Bay Tidal Exchange

Average Depth in Bay, m	2.170
Average Tidal Range, m	0.380
Exchange Ratio, %	17.5

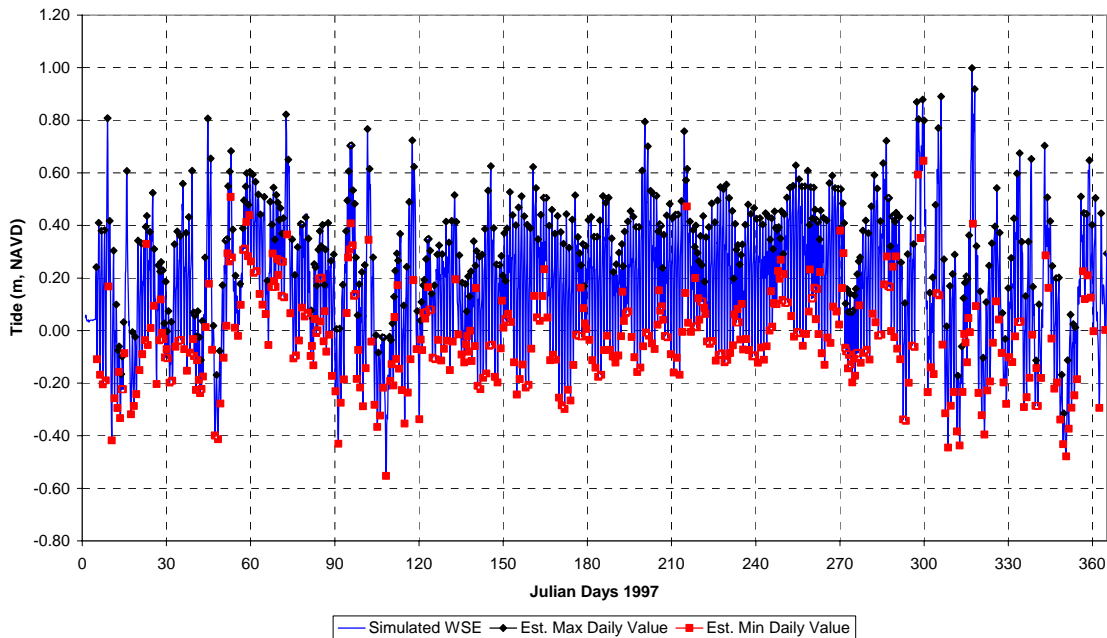


Figure C- 7. Determination of Tidal Range using Simulated Maximum and Minimums

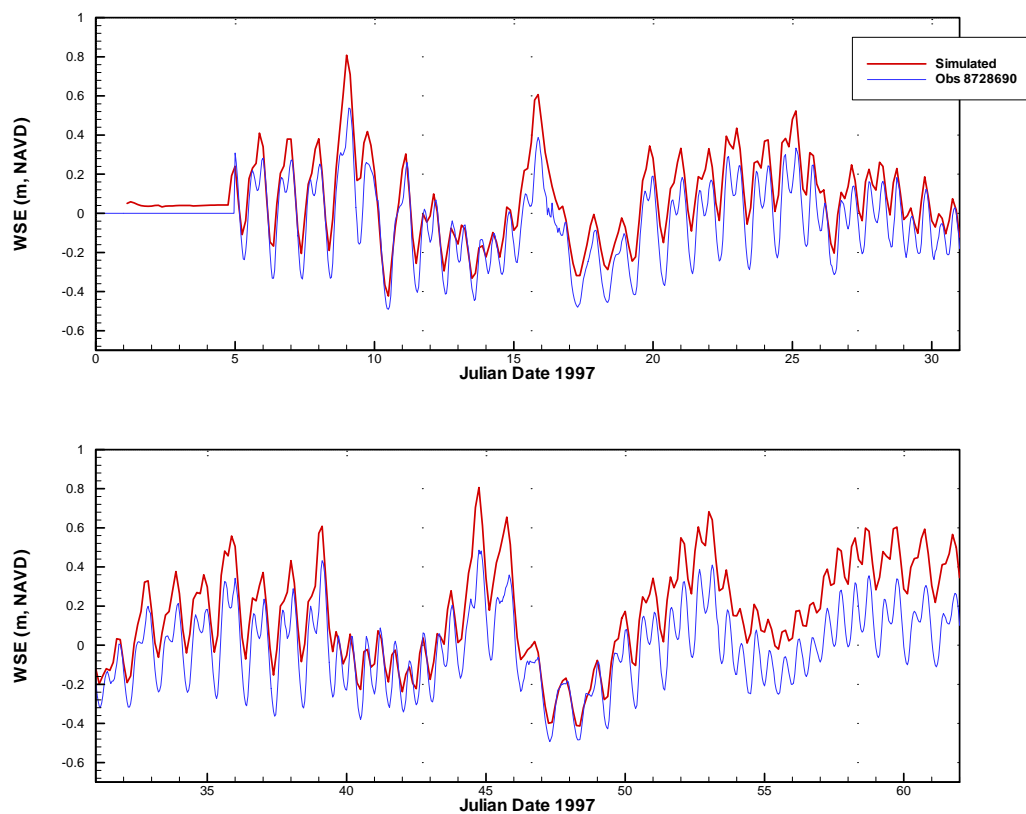


Figure C- 8. Simulated and Observed Tides at NOAA NOS 8728690 (Jan-Feb, 1997)

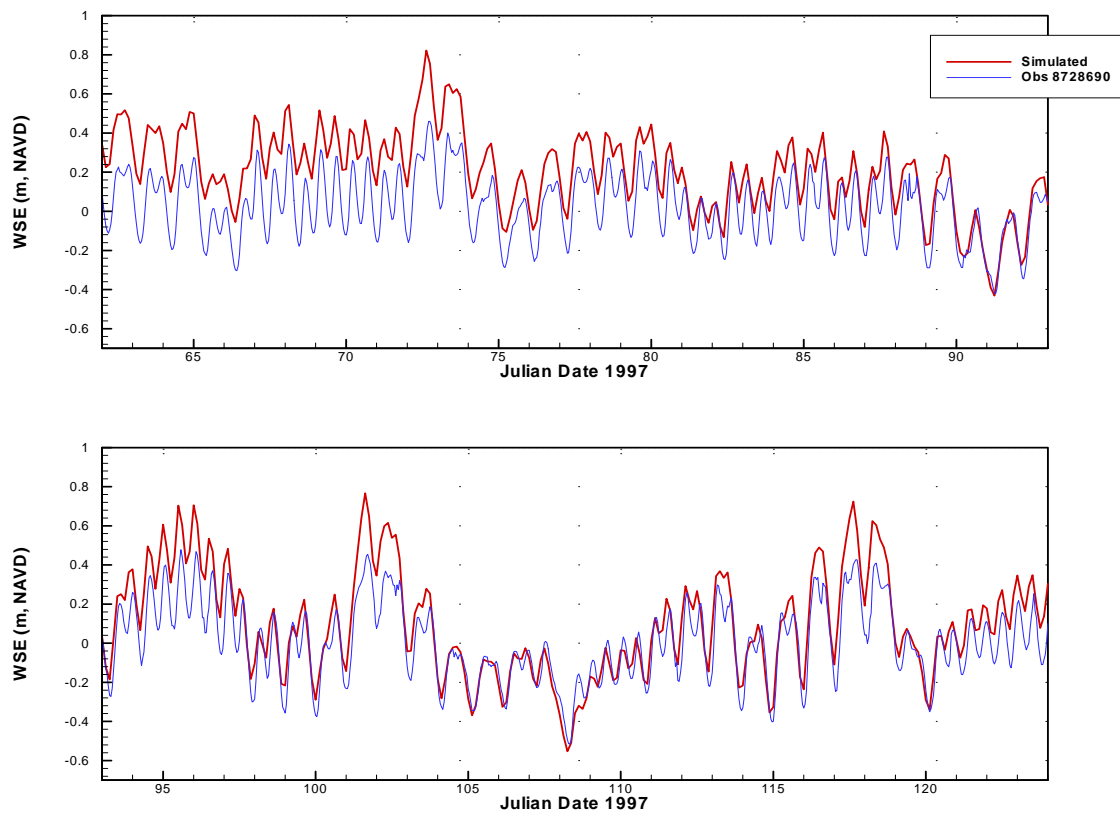


Figure C- 9. Simulated and Observed Tides at NOAA NOS 8728690 (Mar-Apr, 1997)

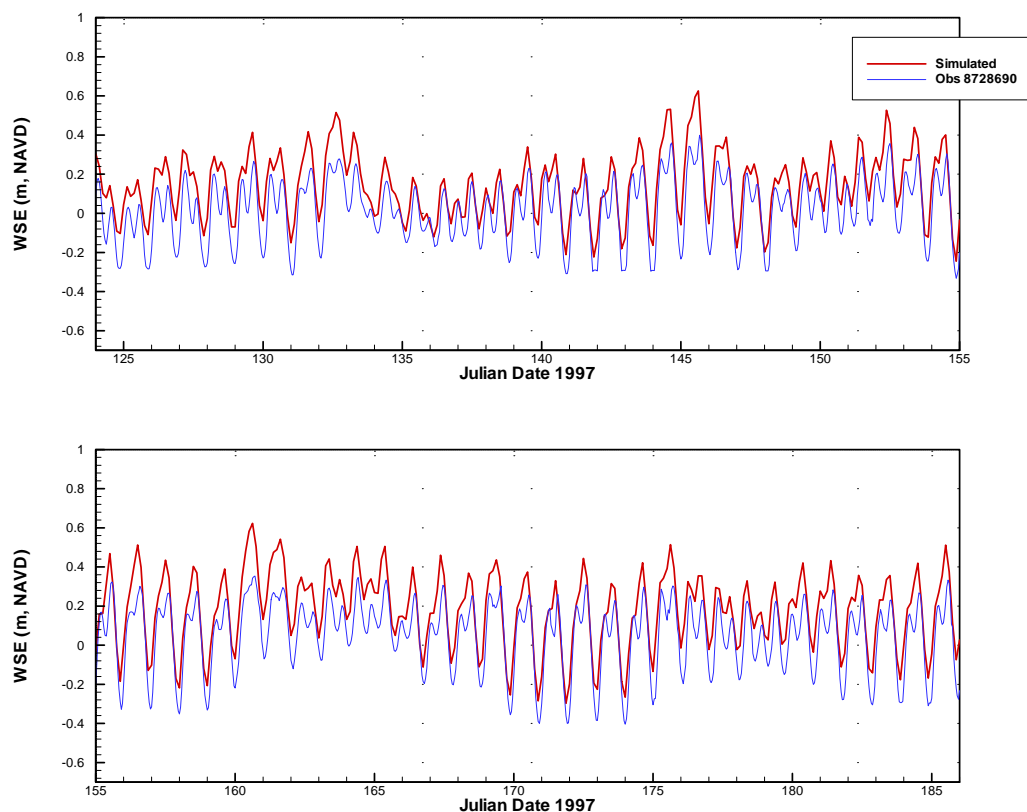


Figure C- 10. Simulated and Observed Tides at NOAA NOS 8728690 (May-Jun, 1997)

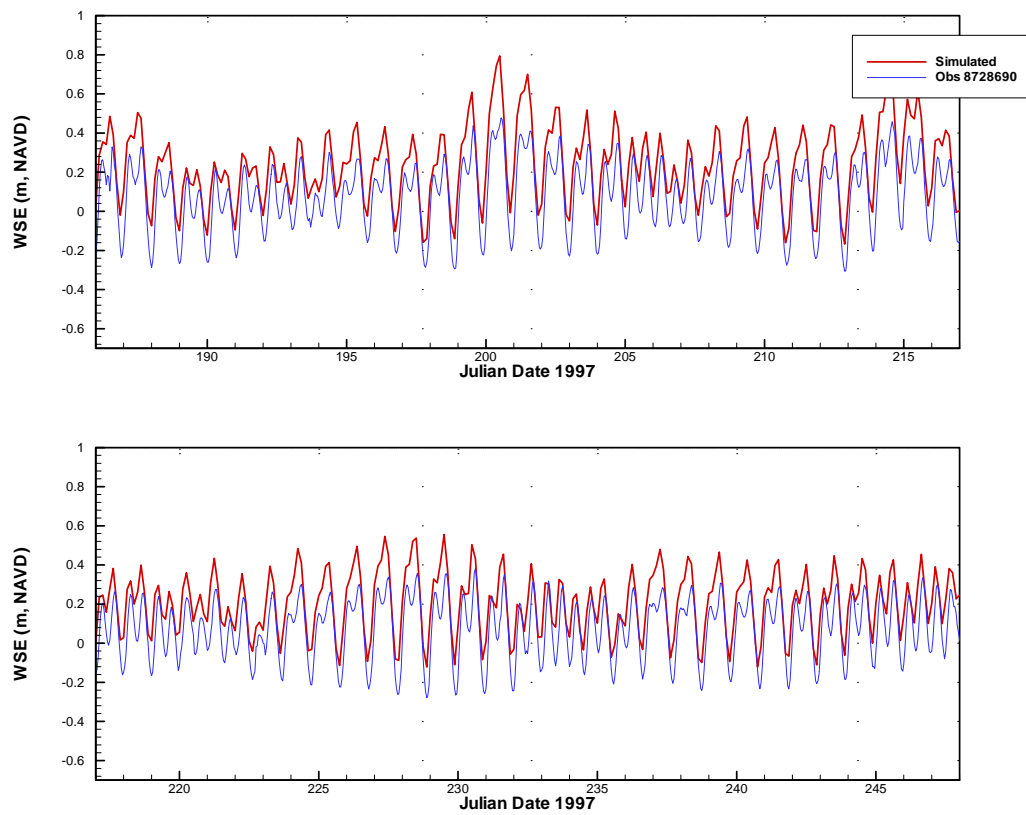


Figure C- 11. Simulated and Observed Tides at NOAA NOS 8728690 (Jul-Aug, 1997)

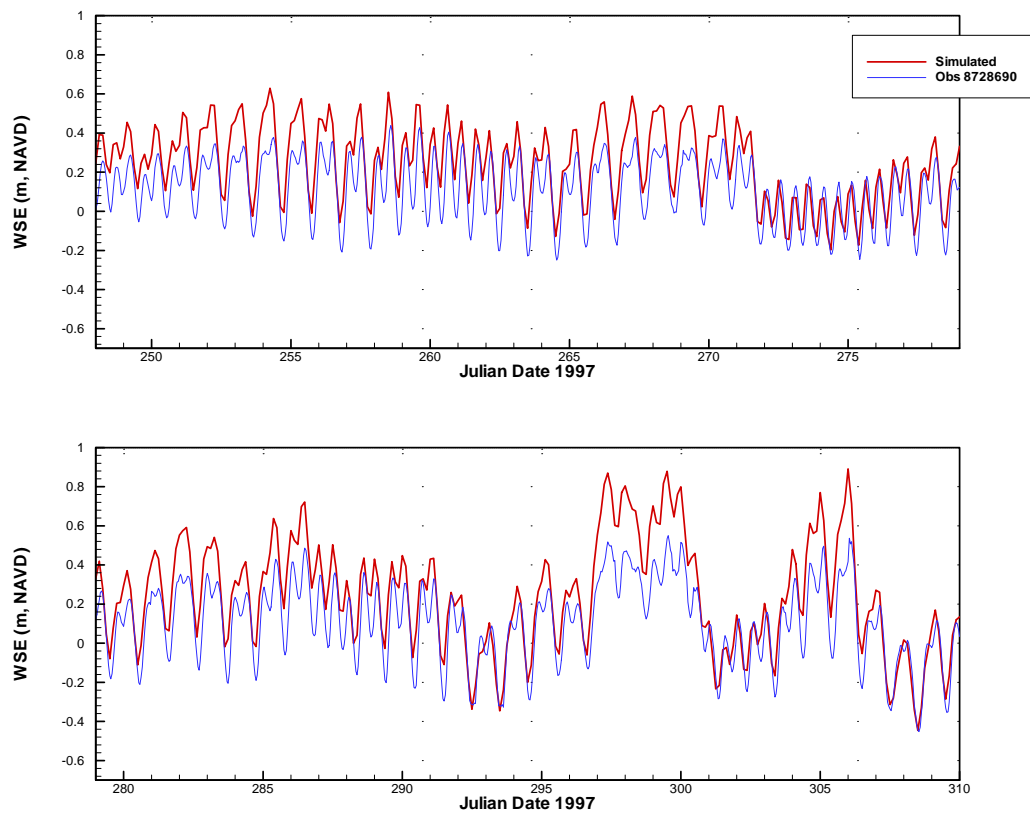


Figure C- 12. Simulated and Observed Tides at NOAA NOS 8728690 (Sep-Oct, 1997)

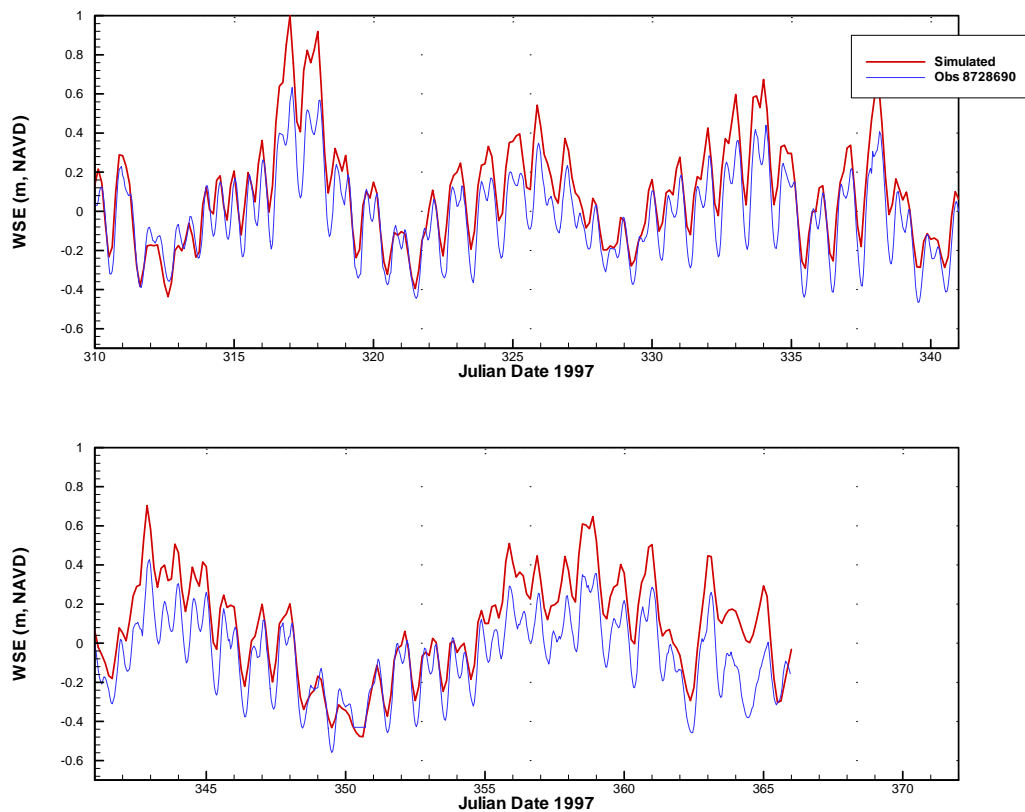


Figure C- 13. Simulated and Observed Tides at NOAA NOS 8728690 (Nov-Dec, 1997)

Fecal Coliform Calibration

The fecal coliform calibration was challenged by limited data. As such, it was more reasonable to simulate relative magnitudes than to match observed data on specific dates. Figure C- 14 presents a location map of the water quality stations in the lower river and bay area used for comparisons. A prominent station for gaging calibration was 21FLA 16270SEAS in WBID 1274. It is located in the upper middle portion of the WBID, near the mouth of Apalachicola River. Simulated and observed data for this station are presented in Figure C- 15. Comparisons for other stations are presented in Figure C- 16 through Figure C- 23. All of these plots reveal that the model is reasonably representing the observed fecal coliform concentrations.

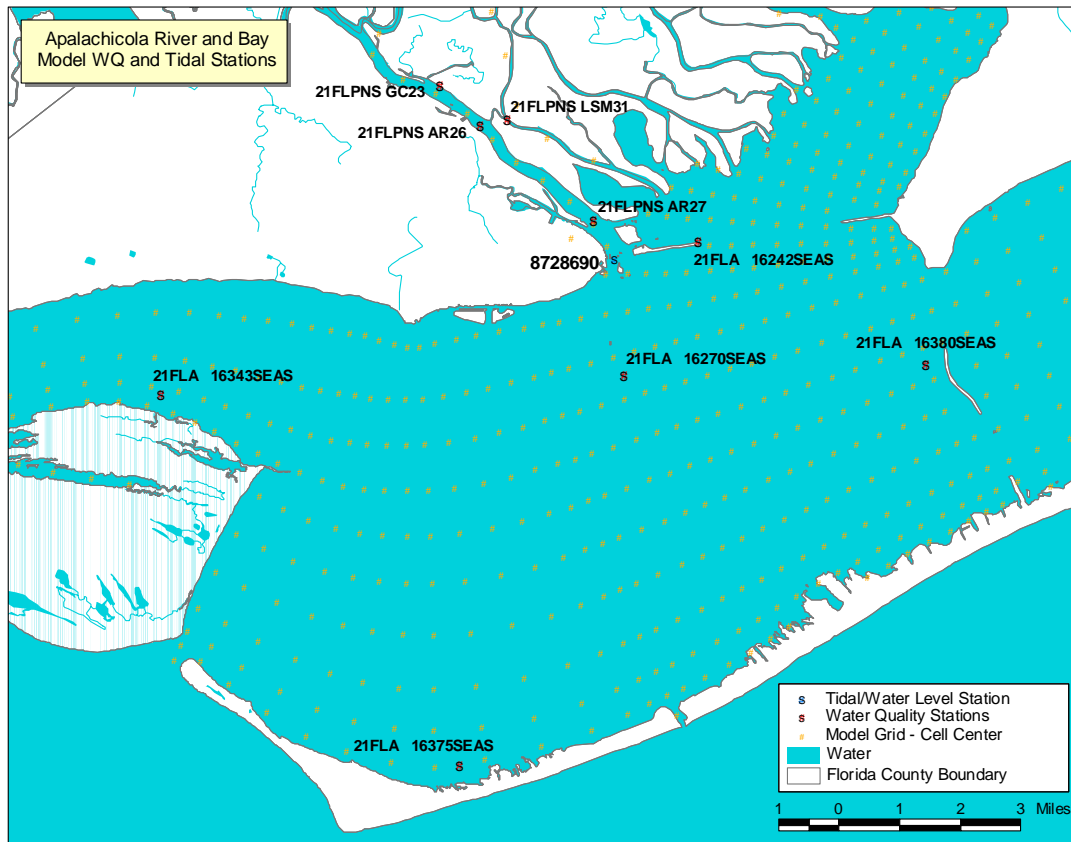


Figure C- 14. Water Quality and Tidal Stations used in Model Calibration

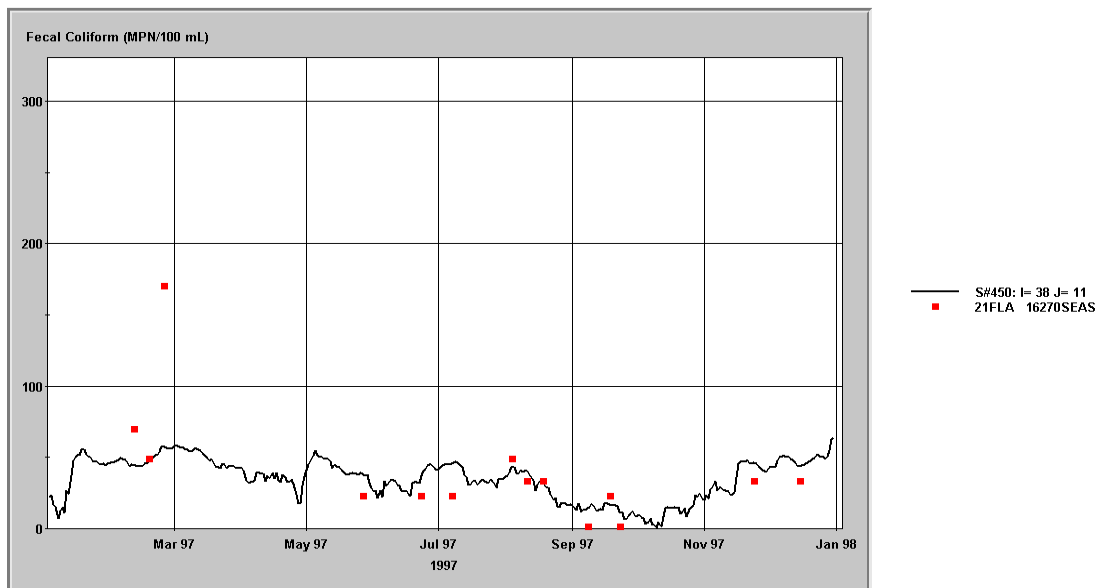


Figure C- 15. Simulated and Observed Fecal Concentrations at Station 21FLA 16270SEAS



Figure C- 16. Simulated and Observed Fecal Concentrations at Station 21FLPNS LSM31

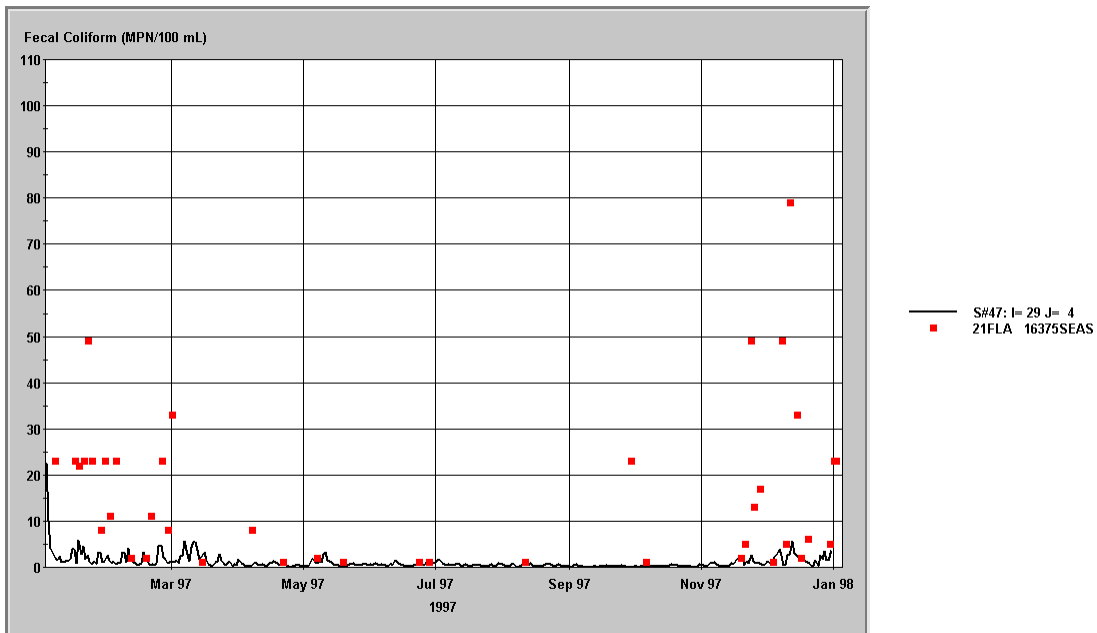


Figure C- 17. Simulated and Observed Fecal Concentrations at Station 21FLA 16375SEAS

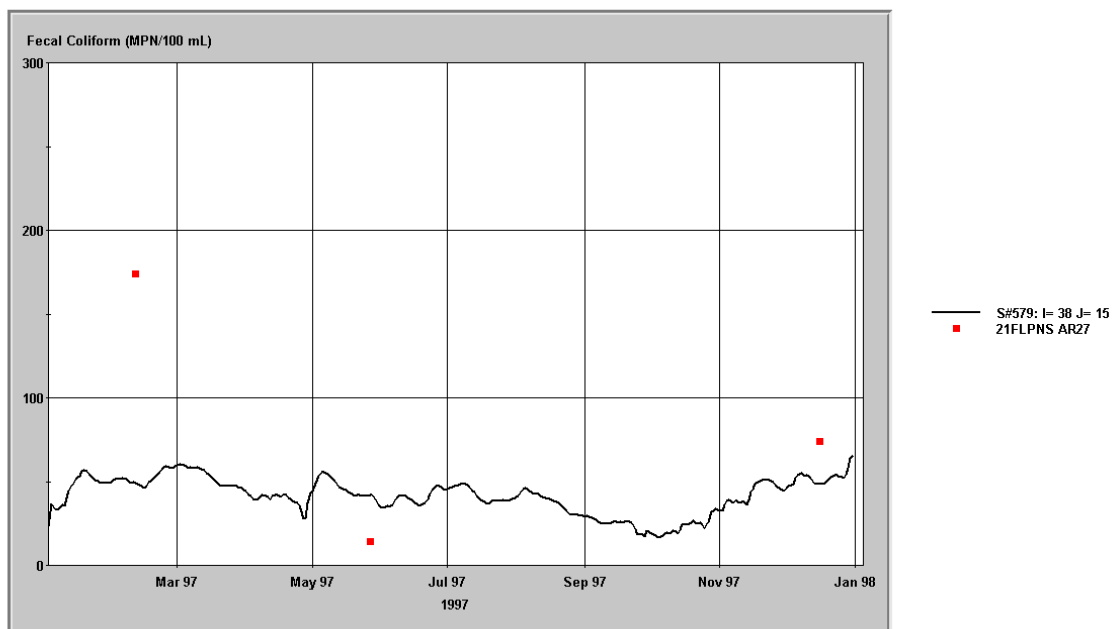


Figure C- 18. Simulated and Observed Fecal Concentrations at Station 21FLPNS AR27

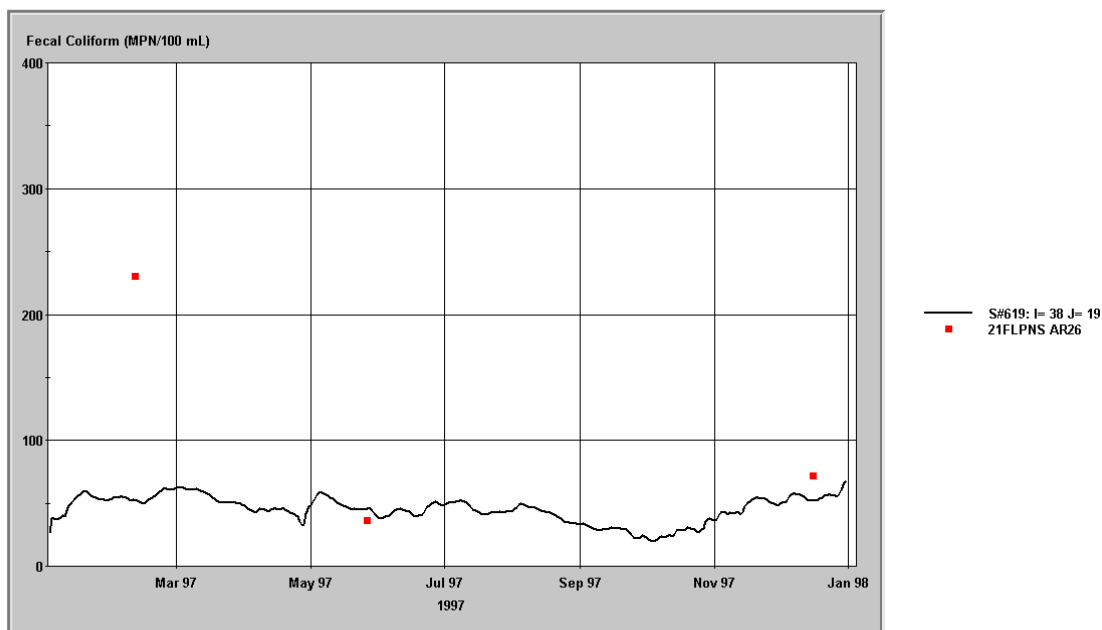


Figure C- 19. Simulated and Observed Fecal Concentrations at Station 21FLPNS AR26

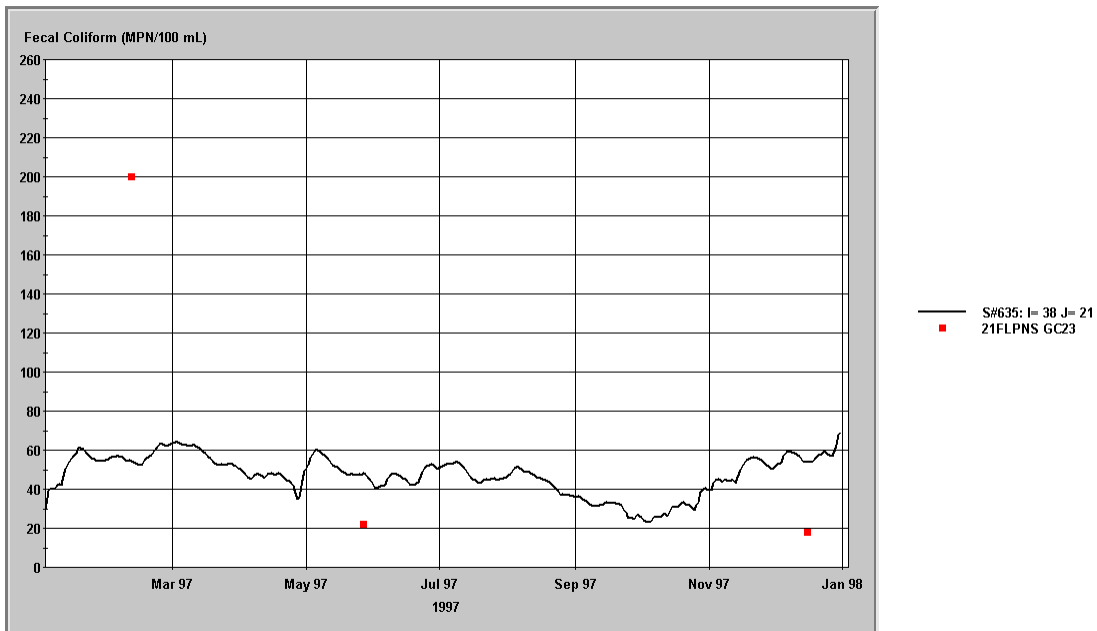


Figure C- 20. Simulated and Observed Fecal Concentrations at Station 21FLPNS GC23

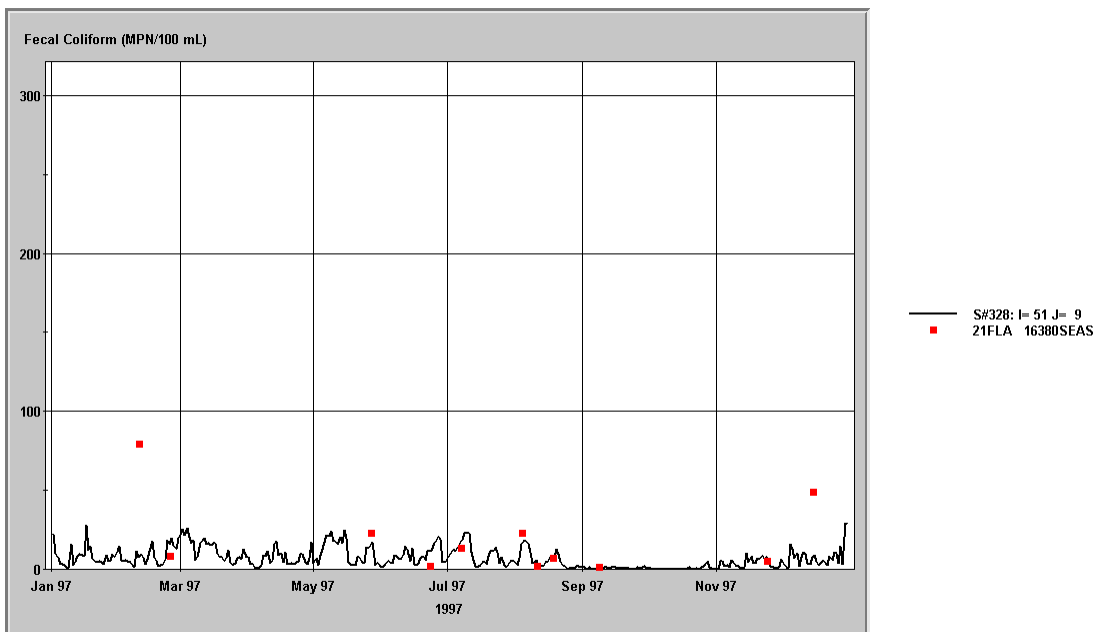


Figure C- 21. Simulated and Observed Fecal Concentrations at Station 21FLA 16380SEAS

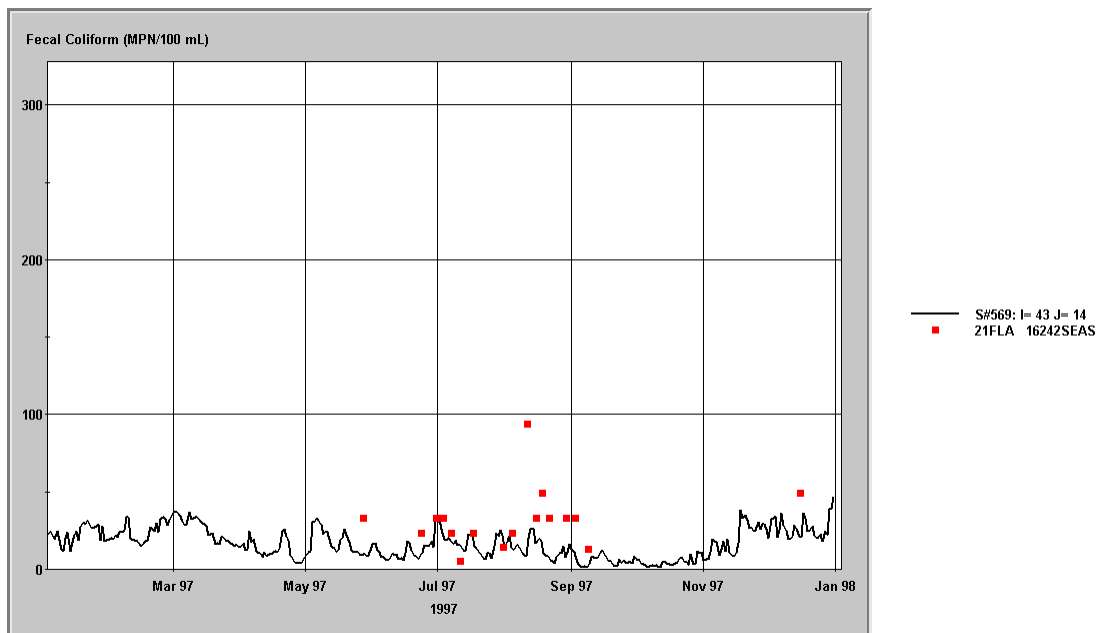


Figure C- 22. Simulated and Observed Fecal Concentrations at Station 21FLA 16242SEAS

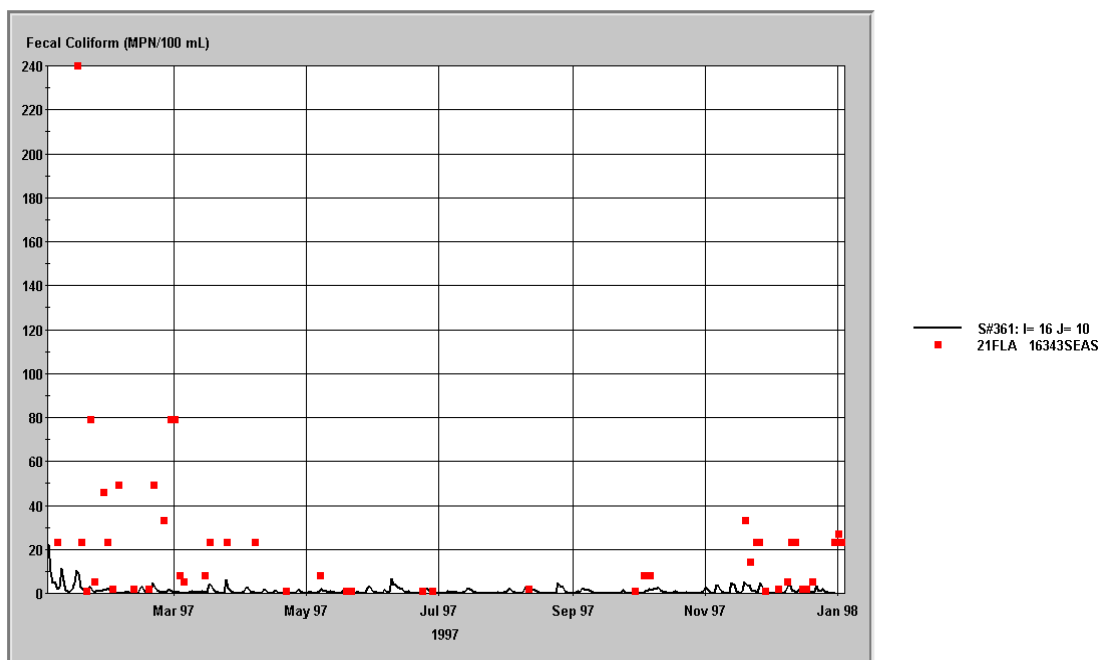


Figure C- 23. Simulated and Observed Coliform Concentrations at Station 21FLA 16343SEAS

Total Coliform Calibration

There were limited total coliform observations available from FDEPs database, which was solely queried for water quality data in this analysis. As such, the existing fecal coliform data were reviewed when concomitant total coliform observations were taken, and an estimated relation was developed. A multiplier of 4.5 was used on the fecal coliform forcing file to develop a total coliform forcing file. The stations used to obtain this multiplier were selected based on their sample period of record, the amount of total coliform data available, and the consistency of water classification due to their locations. Table C- 4 lists the stations summary from which the multiplier was calculated. A model run using this multiplier served as the baseline for total coliform evaluation.

Table C- 4. Summary of Stations used to calculate Total Coliform Multiplier

Station	Station Name	First Date	Last Date	# Obs
21FLPNS AR20	Apalach. R. at Pinhook M6.1	11/12/1996	03/03/1998	9
21FLPNS AR22	Apalach. R. below Jackson R. jct. M5.5	11/12/1996	03/03/1998	9
21FLPNS AR26	Apalach. R. at Four Tree Cut-Off jct. M3.2	11/12/1996	03/03/1998	9
21FLPNS AR27	Apalach R. at Rear Range Beacon M0.5	11/12/1996	03/03/1998	9
21FLPNS GC23	Grassy Cr. mouth M4.4	11/12/1996	03/03/1998	9
21FLPNS LSM31	Little St. Marks R. at Four Tree Cut-Off jct.	11/12/1996	03/03/1998	8
21FLPNS LSM33	Little St. Marks R. at St. Marks R. jct.	11/12/1996	03/03/1998	7
21FLPNS SMR35	St. Marks R. at East R. Cut-Off	11/12/1996	03/03/1998	9

TMDL Development

Model output for 1997 was used to determine TMDL and allocation scenarios because simulated water quality during this year represented critical conditions and provided a well-distributed sample set. The year 1997 was representative of typical weather conditions, but still contained storm events.

TMDL Endpoints

TMDL endpoints represent the instream water quality targets used in quantifying TMDLs and their individual components. For these TMDLs the endpoint is considered as not having more than 10 percent of the simulated daily values exceed 43 MPN/100 mL for fecal coliforms and no more than 10% of the simulated daily values exceed 230 MPN/100 mL for total coliforms. However, an explicit margin of safety was used. The TMDL endpoint was adjusted by 10 percent to 38.7 MPN/100 mL and 207 MPN/100 mL for fecal and total coliforms, respectively. Therefore, 10 percent of the simulated daily values could not exceed 38.7 MPN/100 mL, and 207 MPN/100 mL.

Existing Conditions

The calibrated model provided the basis for performing the allocation analysis. The first step in the analysis involves simulation of baseline conditions, representing existing point and nonpoint source loadings. The model was run for baseline conditions from January 1, 1997 through December 31, 1997. Predicted concentrations of fecal and total coliforms for the listed WBIDs and their tributaries were compared directly to the TMDL endpoints. This comparison allowed evaluation of the expected magnitude and frequency of exceedance under a range of hydrologic and environmental conditions, including dry, wet, and average conditions.

Model results indicate the Apalachicola River transports the greatest loads to Apalachicola Bay. The magnitude of loads discharging directly into the bay is insignificant relative to the loadings transported in the Apalachicola River. Jackson River is one of the largest tributaries discharging into WBID 375B. Loads from Jackson River are modeled as a point source at the upstream boundary of the WBID.

TMDL Allocations

A top-down methodology was followed to develop the TMDLs and allocate loads to sources. Tributaries to Apalachicola Bay were assessed for potential impacts of loading on water quality in the tidally-influenced listed segments. Loading contributions were reduced from applicable sources for these waterbodies and TMDLs were developed. Evaluation of the net impact of nonpoint source reduction on fecal and total coliforms was first evaluated by trial and error reductions, then reviewing the simulation results to ensure compliance with water quality criteria. Reductions made to the loads in WBID 375B resulted in attainment of standards in the downstream WBIDs.

Wasteload Allocations (WLAs)

There are two permitted point source discharges of coliform bacteria within the Apalachicola Bay. Only one, the City of Apalachicola WWTP (NPDES FL0038857), was considered in the TMDL development. However, its DMR data, flow path, and magnitude, remove it from consideration as a reduction.

Load Allocation (LA)

The loading reductions necessary to meet the TMDL were achieved by reducing nonpoint source fecal coliform runoff by 30 percent and total coliform runoff by 15 percent in the Apalachicola River.

TMDL Results

TMDLs were calculated as the average annual loads occurring during critical conditions when coliform concentrations were equal to the water quality endpoint. Tables 3-1 and 3-2 show the TMDLs, overall reductions, and source categories based on the total tributary streamflows in the critical period. The TMDL values are the same for all WBIDs as the greatest loads are transported in the Apalachicola River.

Table C- 5. Fecal Coliform Existing Condition and Allocation Scenario for Apalachicola Bay

WBID	Existing LA Annual Average (MPN/d)	Existing WLA Annual Average (MPN/d)	TMDL LA Annual Average (MPN/d)	TMDL WLA Annual Average (MPN/d)	Percent Reduction LA	Percent Reduction WLA
375A	7.063E+13	5.438E+09	4.945E+13	5.438E+09	30 (see note 1)	0
1274	7.063E+13	5.438E+09	4.945E+13	5.438E+09	0	0

Notes:

1. Reductions required from loadings to the Apalachicola River from areas upstream of WBID 375A. Proposed reductions should result in attainment of water quality standards in Apalachicola Bay.

Table C- 6. Total Coliform Existing Condition and Allocation Scenario for Apalachicola Bay

WBID	Existing LA Annual Average (MPN/d)	Existing WLA Annual Average (MPN/d)	TMDL LA Annual Average (MPN/d)	TMDL WLA Annual Average (MPN/d)	Percent Reduction LA	Percent Reduction WLA
375A	3.179E+14	5.438E+09	2.702E+14	5.438E+09	0	0
375B	3.179E+14	5.438E+09	2.702E+14	5.438E+09	15	0
1274	3.179E+14	5.438E+09	2.702E+14	5.438E+09	0	0
1274B	3.179E+14	5.438E+09	2.702E+14	5.438E+09	0	0

Notes:

1. Reductions required from loadings to the Apalachicola River should result in attainment of water quality standards in Apalachicola Bay.

Fecal Coliform in Shellfish Harvesting Areas

To ensure the proposed reductions resulted in Class II criteria being met at specific shellfish harvesting locations, simulated fecal coliform concentrations at model grid cells corresponding with FDACS monitoring stations were compared to observed concentrations. Figure C- 24 displays the distribution of these stations and their associated grid cells. Table C- 7 lists the stations and

associated cells, and the percentage of simulated data exceeding criteria.

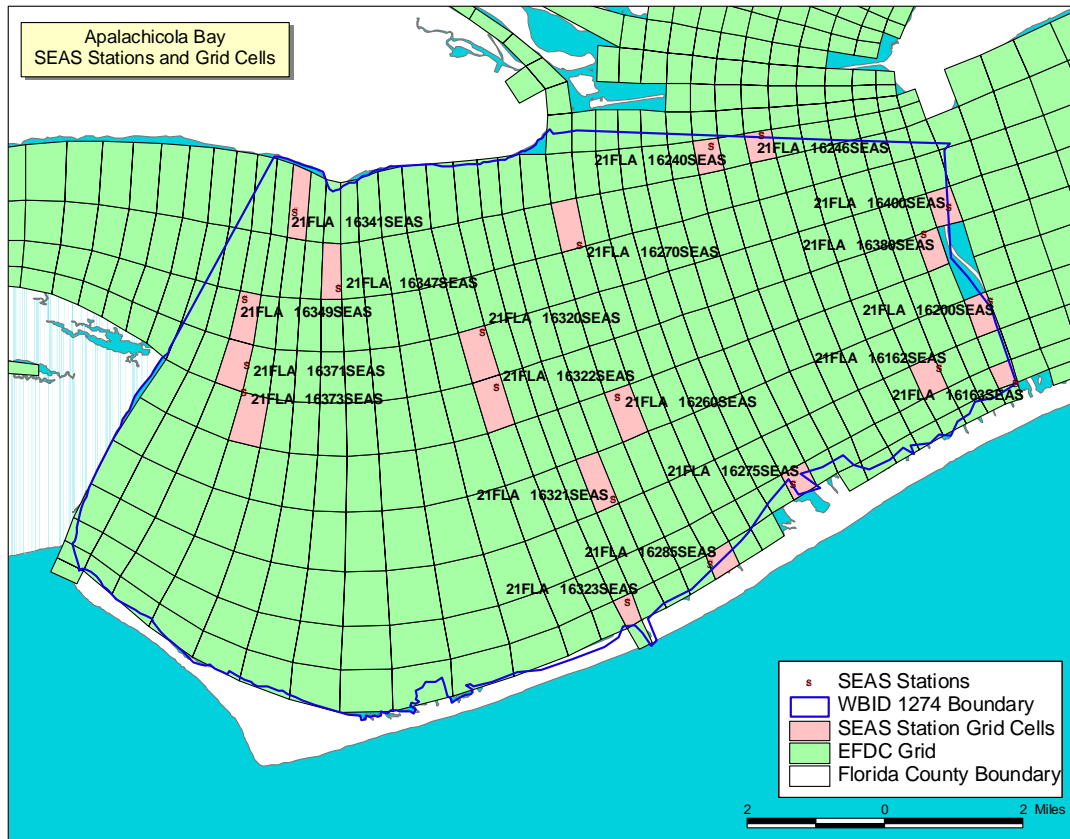


Figure C- 24. SEAS Stations and Corresponding Model Grid Cells

Table C- 7. Predicted Percent Exceedance of Criteria at SEAS Stations

Station	Grid Cell		Fecal Coliforms with 30% Reduction		Total Coliforms with 15% Reduction	
	I	J	% > Criteria	% > Criteria+MOS	% > Criteria	% > Criteria+MOS
21FLA 16162SEAS	49	5	0	0	0	0
21FLA 16163SEAS	52	4	0	0	0	0
21FLA 16200SEAS	52	6	0	0	0	0
21FLA 16240SEAS	44	12	0	0.274	0	0.274
21FLA 16246SEAS	46	12	0	0	0	0
21FLA 16260SEAS	38	7	0	0	0	0
21FLA 16270SEAS	38	11	0.548	5.480	0.548	7.123
21FLA 16275SEAS	43	4	0	0	0	0
21FLA 16285SEAS	39	3	0	0	0	0
21FLA 16320SEAS	33	9	0	0	0	0

Station	Grid Cell		Fecal Coliforms with 30% Reduction		Total Coliforms with 15% Reduction	
	I	J	% > Criteria	% > Criteria+MOS	% > Criteria	% > Criteria+MOS
21FLA 16321SEAS	36	6	0	0	0	0
21FLA 16322SEAS	33	8	0	0	0	0
21FLA 16323SEAS	35	3	0	0	0	0
21FLA 16341SEAS	26	12	0	0	0	0
21FLA 16347SEAS	28	11	0	0	0	0
21FLA 16349SEAS	24	10	0	0	0	0
21FLA 16371SEAS	24	9	0	0	0	0
21FLA 16373SEAS	25	8	0	0	0	0
21FLA 16380SEAS	51	8	0	0	0	0
21FLA 16400SEAS	52	9	0	0	0	0

APPENDIX D FECAL COLIFORM TMDL FOR HUCKLEBERRY CREEK (WBID 1286)

(prepared by FDEP and available as a separate file)